~~Security-Related Information - Withhold Under 10 CFR 2.390~~

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B.5.b Phase 2 & 3 Submittal Guideline

NEI

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Prepared by:

ERIN® Engineering and Research, Inc.
An SKF Group Company

2175 N. California Blvd., Suite 810
Walnut Creek, CA 94596

FOREWORD

This guideline has been developed to assist licensees in developing regulatory submittals that describe their approach to addressing the mitigating strategies committed in the industry proposal for closing Phase 2 and Phase 3 of Section B.5.b of the 2002 ICM. The Phase 2 proposal was described in an NEI letter to the NRC dated January 24, 2006 [Ref. 1]. The Phase 3 proposal was described in an NEI letter to the NRC dated June 27, 2006 [Ref. 2].

The plant conditions evaluated in this guideline are beyond design basis and outside of the regulatory scope. This guideline and the conditions considered are not generally considered Safeguards Information. However, some of the information contained herein is sensitive and should be handled in accordance with 10 CFR § 2.390.

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1.0 INTRODUCTION

Nuclear power plants are designed and operated based on the concept of design basis events. In the security area, nuclear power plant licensees are responsible for providing assurance that their sites are capable of withstanding design basis security threats and for taking reasonable measures to assure that available resources are used effectively in responding to beyond design basis threats. With the potential spectrum of beyond design basis terrorist threats being essentially unlimited, it is not feasible to define a "bounding" scenario. Thus, a pragmatic approach is required.

In light of this situation, all nuclear utilities undertook an evaluation of potential damage to their facilities in an effort to enhance plant-specific mitigation capability for damage conditions potentially affecting systems important to preventing core damage and release caused by a large explosion or fire. The objective of these site-specific assessments was to utilize a threat-independent methodology to identify potential plant-specific strategies for preventing or mitigating damage to the fuel. These assessments have identified a wide spectrum of potential plant-specific enhancements for consideration, and a collective review of these assessments yielded some important high-level insights:

- Prediction of precise damage states, plant conditions, and associated plant response is not possible, even on a site-specific basis.
- Bounding damage states are of little value in assessing and enhancing plant capabilities.
- The potential endless combinations and permutations of potential damage states are imponderable.
- Some potential damage scenarios can impact the normal command and control structure due to personnel impacts and/or loss of control room.
- A flexible response capability is desirable. Such a capability provides the industry with an increased potential to address these extreme conditions.
- The value of costly new fixed hardware capability is not guaranteed, as the damage state could just as easily disable any new fixed capability as well as the existing capability.
- Identified response capabilities will not ensure success under the full spectrum of potential damage states.

With this enhanced level of understanding of the situation, the following four components have been identified for implementation to address B.5.b Phases 2 and 3:

- Internal SFP Makeup Strategy
- External SFP Makeup & Spray Strategy
- Enhanced Initial Command and Control for Reactor Challenges
- Enhanced Response Strategies for Reactor Challenges

2.0 SPENT FUEL POOL STRATEGIES

2.1 BACKGROUND

In 2005, as part of the Industry Spent Fuel Pool Mitigation Strategy (Phase 2) Study sponsored by NEI, each site has developed a site specific assessment of mitigation strategies for spent fuel pool damage scenarios. The NRC conducted a site specific assessment of mitigation strategies as well. Both NEI and NRC issued site specific report outlining potential enhancement strategies.

In January 2006, the nuclear industry proposed to enhance the spent fuel mitigation capability of every operating nuclear power plant [Ref. 1], as an alternative to the site specific assessments. The industry approach was developed by a Chief Nuclear Officer (CNO) Review Panel. After reviewing the results of the industry and NRC Phase 2 studies, it became apparent to the CNO Review Panel that a combination internal and external strategy is the most efficient and effective way to address this issue and offers the best chance for success from a spectrum of potential scenarios. The most attractive feature of the two strategies is the flexibility they provide for responding to the wide range of potential scenarios.

The internal strategy involves implementation of a diverse makeup capability within the plant that can provide at least 500 gpm of SFP makeup. The external strategy involves the use of a portable SFP makeup and spray capability that enhances the robustness and flexibility of site response. The implementing guidance for the external strategy must include steps to assist the plant staff in determining whether use of the external strategy in the makeup mode is preferred, or if use in the spray mode is appropriate.

Subsequent interactions between the NRC and NEI further clarified the elements of the SFP mitigation capabilities [Ref 3, 4]. This section describes the objectives, performance requirements and submittal elements that each site must provide to close out Phase 2 of the B.5.b response. Additional guidance is provided on each aspect of the submittal in order to facilitate strategy development and submittal preparation. In addition, an industry template for response on SFP mitigation is provided in Appendix A.2. Providing a response in accordance with this guideline addresses all of the response elements requested by the NRC in Enclosure 3 of the site-specific Phase 2 letters. NOTE: These strategies are not required for sites that have spent fuel pools that are below grade and can not be drained. These plants have been notified by the NRC.

2.1.1 Strategy Implementation

The implementation of these SFP mitigation strategies significantly enhances the overall response capability of each site. In order to effectively deploy these strategies, it is anticipated that sites will develop procedures/guidance that directs the deployment of the appropriate strategy. A generalized decision process for implementing the internal and external makeup and spray strategies is provided in Figure 2-1.

The entry conditions for this process should be outside the normal makeup capability. That is, the normal makeup capability is still considered to be sufficient for all design basis considerations and the internal and external strategies would only be called for if the normal makeup systems are insufficient, or if their effectiveness cannot be determined due to the damage state.

The first step of the decision process is to determine whether the area around the spent fuel pool is accessible. Accessibility can be impacted by the local damage condition (e.g., degraded conditions due to structural or fire-related impacts), or by radiation dose (e.g., due to fuel uncovery). If the area is not accessible, then makeup to the spent fuel pool should be initiated using all available means. If local spray is available (i.e., spraying of the fuel in the spent fuel pool from the area around the spent fuel pool), then it should be deployed. If not, then external spray should be deployed (i.e., spray from outside the structure to cool fuel and/or reduce radionuclide release).

If the area around the spent fuel pool is accessible, then a determination of the spent fuel pool leakage rate should be made. This determination should focus on the relative rate of loss of inventory is excessive (i.e., does pool level indicate that the leak rate is likely greater than 500 gpm, or is dose rate excessive due to fuel uncovery). If it can be determined that the leakage rate is not excessive, then makeup should be initiated using the internal strategy, supplemented by the external makeup strategy, as necessary to maintain or restore water level. If those makeup sources are ineffective and spent fuel pool level is dropping, then the option for spray should be considered.

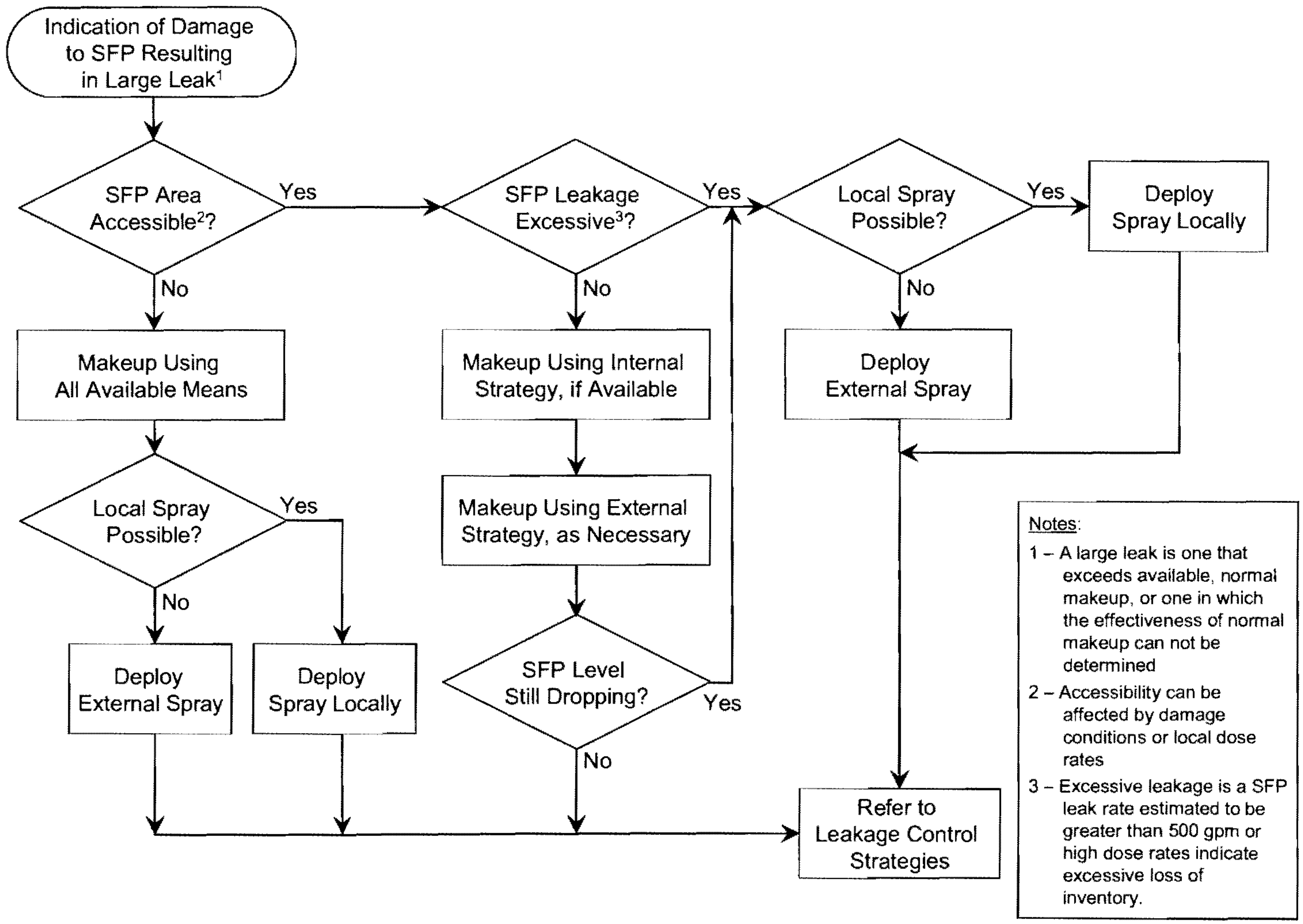
This option applies either when the leakage rate has been determined to be excessive, or when internal/external makeup sources are ineffective in restoring SFP level. In these cases, the preference is for local spray, but if local spray can not be deployed, then external sprays are called for.

In cases where water level is not maintained, leakage control strategies should be considered.

The appropriate site-specific approach to be taken to implement this set of strategies in plant procedures/guidance is left to the site to determine.

Figure 2-1

Generalized Decision Process for SFP Makeup vs. Spray



2.2 DIVERSE SFP MAKEUP SOURCE (INTERNAL STRATEGY)

Objective:

Establish a diverse means of SFP makeup with at least a concurrent makeup capability of 500 gpm beyond the normal SFP makeup capability.

Performance Attributes:

1. The concurrent SFP makeup capability of 500 gpm is the total flow rate of water that can be simultaneously supplied to the pool beyond the normal SFP makeup capability. This total concurrent makeup capability can be accomplished with multiple systems beyond the normal makeup system, but all must be diverse from the normal makeup system. NOTE: Line losses need to be considered in estimating flow rates. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation.
2. The term "diverse" means that the makeup source does not rely upon any of the same components or piping as the normal makeup source. This includes power supplies that are located in the same building as the SFP. An obvious example of a potentially diverse makeup source might be the fire water system headers in the vicinity of the spent fuel pool with a sufficient number of fire hoses as a means to provide SFP makeup.

Response Elements:

- Provide a general description of diverse Spent Fuel Pool (SFP) makeup capability, including the necessary personnel actions.
- Describe how this capability meets the NEI guidance as "diverse".
- Describe the locations of the primary equipment involved in implementing this strategy.
- Estimate flow rates expected to be delivered to the SFP and identify the capacity of water supplies.

Submittal Guidance:

The evaluation of this strategy should begin with the existing SFP makeup capability that already exists beyond the normal SFP makeup system. If the plant has an existing diverse makeup capability beyond the normal SFP makeup system that exceeds 500 gpm, then no additional enhancement strategies need to be implemented. The existing capabilities should be documented in the submittal using the template provided in Table A.2-1.

In the event the site does not have a diverse concurrent makeup capability beyond the normal SFP makeup system that exceeds 500 gpm, then the site assessment reports compiled by ERIN Engineering and Research, Inc. and the NRC should be reviewed to identify potential enhancement strategies to establish 500 gpm of diverse makeup. Due to the fact that these enhancement strategies were identified without detailed technical review, each site should evaluate each identified enhancement strategies to determine the true feasibility and benefit of each with consideration of at least the following:

- Whether the strategy represents a diverse makeup capability from the normal makeup system (i.e., makeup pathway not dependent on components or piping of the normal makeup system).
- Whether the strategy provides additional tangible makeup capability beyond that already available (i.e., the 500 gpm criteria).
- Whether the strategy can feasibly be accomplished in the time available and plant conditions that may exist.
- Whether the strategy can be incorporated into plant procedures and training without unduly impacting the existing training regimen.

If the diverse concurrent makeup capability is less than 500 gpm beyond the normal SFP makeup capability, then the site must identify and implement additional mitigation strategies. Attachment A of Reference 1 provides a generic list of candidate mitigation enhancement strategies identified in the NEI and NRC Phase 2 studies. Sites requiring additional concurrent makeup capability may review this list and brainstorm plant-specific options for establishing a diverse means of providing a minimum of 500 gpm of concurrent makeup capability in excess of the normal SFP makeup system. In some cases, this may involve identification of strategies not included in the original studies. In other cases, minor plant modifications may be necessary. In either case, sites are expected to assure that a diverse concurrent makeup capability of at least 500 gpm can be provided to the SFP. The selection of the makeup capability option to utilize in enhancing makeup capability will be left to the site's discretion. It is recognized that some items in Attachment A may share SFP makeup piping and components at some plants and would not qualify as diverse.

The enhanced SFP makeup capabilities should be documented in the submittal using the template provided in Table A.2-1.

Additional Considerations:

1. For the purposes of this strategy, it is acceptable to utilize makeup sources that would require access to areas around the spent fuel pool, including the spent fuel pool deck area.
2. In identifying strategies, there is no need to consider additional concurrent events at the site. Thus, all plant systems can be considered available as options, including fire protection systems.

3. If flexible hoses (e.g., fire hoses) are to be relied upon to deliver flow to the SFP, then some means to secure the hose is required to assure that the water is delivered into the pool. (e.g. tie downs or unmanned nozzle)
4. There is no need to consider the potential for equipment to be out of service for routine maintenance activities. This also means that there is no need to provide redundancy in the means of makeup.
5. Strategy can be implemented through guidance or procedures, consistent with the site's chosen approach. Steps are expected to be general in nature, consistent with the need for flexibility in deployment. That is, there is no need to develop scenario-specific procedures.
6. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.
7. Prior to the event, the plant systems are assumed to be in a nominal configuration with the reactor at 100% power.
8. Implementation of this strategy is not expected to require extraordinary or heroic actions. In an event, the utility emergency response organization (ERO) will decide on the potential benefit and feasibility of the strategy in light of plant conditions. For example, it is expected that dose rates and other accessibility considerations will be addressed at the time of the event, in light of the actual plant conditions. This input will be considered by the ERO in directing plant response actions.

2.3 FLEXIBLE, POWER-INDEPENDENT MAKEUP SOURCE (EXTERNAL STRATEGY)

The external strategy actually contains two functional objectives: SFP makeup and SFP spray capability. The first objective is aimed at providing yet another means to provide makeup to the SFP. The second objective is to provide spray to the pool in the event the pool water level can not be maintained. Spray flow needs to be coordinated with hot fuel dispersal. The external strategies are not required to be implemented simultaneously and may rely on the same pumping capability and water sources. Appendix B provides supplementary information on examples of commercially available pumping systems and monitor nozzles.

2.3.1 SFP Makeup Capability

<u>Objective</u>:

Establish a flexible means of SFP makeup of at least 500 gpm using a portable, power-independent pumping capability.

Performance Attributes:

1. Portable pumping capability sufficient to supply pool makeup directly at a rate of at least 500 gpm. NOTE: Line losses need to be considered in estimating flow rates. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation.
2. The external strategies are not required to be implemented simultaneously and may rely on the same pumping capability.
3. For dual unit sites that share a spent fuel pool the flow rate is at least 500 gpm of direct makeup to the SFP. This may rely on the same pumping capability as the SFP spray.
4. For dual unit sites that have spatially separated pools the flow rate will be required to be at least 500 gpm of direct makeup to the SFP for each pool and is not required to be implemented simultaneously. This may rely on the same pumping capability as the SFP spray.
5. This capability could be in the form of an on-site fire pumper truck or an onsite, external portable pump. The pump is anticipated to be diesel driven, but an alternative could be an AC powered pump using jumper cables from an onsite emergency power source that is spatially separated from the vicinity of the spent fuel pool.
6. While an independent pumper truck or portable pump is required to be available for this strategy, the external fire protection system ring header is an acceptable water source to supply the pump, provided damage to the header and distribution piping in the vicinity of the spent fuel pool structure can be isolated. NOTE: Since deployment of the external makeup strategy using firewater could in many cases be quicker, if available, it can be considered as part of the strategy.
7. Sufficient fuel for the pumping source to operate for 12 hours without off-site supplies.
8. Adequate suction supply piping to allow the portable pumping capability to be located such that the potential makeup/spray deployment locations can be serviced.
9. A means to assure that sufficient water sources are available to operate the system for at least 12 hours at the flow rate anticipated to be provided. At an anticipated makeup rate of 500 gpm, this is equivalent to 360,000 gallons.
10. Sufficient hose to allow makeup directly to the SFP at a rate of at least 500 gpm from each accessible side of the structure containing the SFP (may require multiple hoses). This includes a means to secure the hoses at or near the SFP to ensure the hose directs the water into the SFP.

11. The system should be capable of being deployed within 2 hours from the time plant personnel diagnose that external SFP makeup is required.
12. Example specifications for portable, power-independent pumps are included in Appendix B.1.

Response Elements:

- Provide a general description of alternate SFP makeup capability, including the necessary personnel actions.
- Describe the general locations of the primary equipment involved in implementing this strategy.
- Estimate flow rates expected to be delivered to the SFP and identify the capacity of water supplies.
- Confirm that procedure/guidance has been or will be developed for implementing this strategy.

Submittal Guidance:

It is impossible to predict the specific damage condition that might occur as a result of a beyond design basis security threat. Further, conditions may prevent the implementation of the diverse SFP makeup internal strategy for providing pool cooling. Therefore the industry approach is for each site to have a flexible, deployable, external mitigation capability on-site. Such an alternate capability should be devised to provide sufficient makeup capability for a spectrum of potential conditions, and take advantage of site design features that can be beneficial in responding.

The water makeup capability will be employed by connecting hoses to the discharge of a portable pump and manually routing the hoses to support a discharge flow rate of at least 500 gpm into the spent fuel pool.

As the range of possible damage states cannot be predicted, adverse environmental and radiological conditions may impose significant challenges to the mitigation response teams implementing the proposed strategy. In a real event, environmental and radiological conditions will be monitored to assess safe access and exposure of the mitigation response teams. The ability to perform the strategy will be determined by this assessment.

The external SFP makeup capability should be documented in the submittal using the template provided in Table A.2-2.

Additional Considerations:

1. For the purposes of this strategy, it is acceptable to assume access to areas around the spent fuel pool, including the spent fuel pool deck area.

2. This strategy assumes that the leakage rate from the pool is not so excessive to prevent the strategy from being initially deployed due to high radiation levels.
3. The external strategies (i.e., SFP makeup and spray) are not required to be implemented simultaneously and may rely on the same pumping capability.
4. While an independent pumper truck or portable pump is required to be available for this strategy, the external fire protection system ring header is an acceptable water source to supply the pump, provided damage to the header and distribution piping in the vicinity of the spent fuel pool structure can be isolated. NOTE: Since deployment of the external makeup strategy using firewater could in many cases be quicker, if available, it can be considered as part of the strategy. It is recognized that fire system at many sites is the most flexible system that can be employed to mitigate many of the elements associated with this effort. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.
5. If flexible hoses (e.g., fire hoses) are to be relied upon to deliver flow to the SFP, then some means to secure the hose is required to assure that the water is delivered into the pool (e.g., tie downs or unmanned nozzle).
6. There is no need to consider the potential for equipment to be out of service for routine maintenance activities. This also means that there is no need to provide redundancy in the means of makeup.
7. Equipment associated with the external strategy is not to be treated as safety-related equipment. As such, it is not subject to any new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).
8. Equipment associated with the external strategy will meet standard industry practices for procuring and maintaining commercial equipment.
9. Strategy can be implemented through guidance or procedures, consistent with the site's chosen approach. Steps are expected to be general in nature, consistent with the need for flexibility in deployment. That is, there is no need to develop scenario-specific procedures.

10. In assessing deployment times, assume access is not inhibited to the areas required for strategy implementation.
11. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.
12. The implementing guidance for the external strategy must include steps to assist the plant staff in determining whether use of the external strategy in the makeup mode is preferred, or if use in the spray mode is appropriate.
13. The portable pumping capability will need to be stored on-site approximately 100 yards or more away from the SFP in order to assure survivability and availability for the spray function. Connecting devices and hoses that will be employed in the vicinity of the SFP can be stored on the spent pool deck or in stairwells.
14. It is acceptable for the portable pumping source to also be used for fire fighting (e.g., an onsite fire pumper truck).
15. It is acceptable for the portable pumping source to be periodically taken offsite (e.g., for fire fighting training). However, if the location offsite would preclude deployment within the required time, the amount of time the pump is unavailable should be limited based on site work control processes.
16. Prior to the event, the plant systems are assumed to be in a nominal configuration with the reactor at 100% power.
17. Implementation of this strategy is not expected to require extraordinary or heroic actions. In an event, the utility emergency response organization (ERO) will decide on the potential benefit and feasibility of the strategy in light of plant conditions. For example, it is expected that dose rates and other accessibility considerations will be addressed at the time of the event, in light of the actual plant conditions. This input will be considered by the ERO in directing plant response actions.

2.3.2 SFP Spray Capability

Objective:

Establish a flexible means of providing at least 200 gpm per unit of spray to the spent fuel pool using a portable, power-independent pumping capability.

Performance Attributes:

1. Portable pumping capability sufficient to supply one or more monitor nozzles located to spray the SFP at a flow rate of at least 200 gpm per unit.
2. The external strategies are not required to be implemented simultaneously and may rely on the same pumping capability.

3. For dual unit sites that have separate pools the flow rate will be required to be at least 200 gpm of spray to the SFP for each pool and is not required to be implemented simultaneously. These may rely on the same pumping capability as the SFP makeup.
4. For dual unit sites that share a spent fuel pool the flow rate will be required to be at least 400 gpm of spray to the SFP. This higher flowrate is required for two reasons. First, dual unit pools are generally larger than single unit pools. Second, a dual unit pool generally has a higher overall heat load due to the second unit. This may rely on the same pumping capability as the SFP makeup.
5. This capability could be in the form of an on-site fire pumper truck or an onsite, external portable pump. The pump is anticipated to be diesel-driven, but an alternative could be an AC-powered pump using jumper cables from an onsite emergency power source that is spatially separated from the vicinity of the spent fuel pool and the other critical areas of station associated with Phase 3.
6. Sufficient fuel for the pumping source to operate for 12 hours without off-site supplies.
7. Adequate suction supply piping to allow the portable pumping capability to be located such that the potential makeup/spray deployment locations can be serviced.
8. A means to assure that sufficient water sources are available to operate the system for at least 12 hours at the above specified flow rate, i.e. 200 gpm for separate pools and 400 gpm for shared pools.
9. Sufficient hose to spray the SFP at a rate of at least 200 gpm per unit from each accessible side of the structure containing the SFP. This may require multiple hoses.
10. When fuel is stored in an undispersed configuration, the system should be capable of being deployed within 2 hours from the time plant personnel diagnose that external SFP makeup is required. Once the fuel is dispersed, then the system should be capable of being deployed within 5 hours from the time plant personnel diagnose that external SFP makeup is required.
11. Example specifications for oscillating monitor nozzles are included in Appendix B.3. Other spray dispersal methods are also acceptable (e.g., water curtains), provided that they meet the other requirements of this strategy.
12. Sufficient portable spray monitor nozzles and associated hoses to provide a spray over the entire spent fuel pool (assuming freshly discharged fuel has been distributed). This may best be accomplished with oscillating monitor nozzle(s).

13. Implementing guidance should identify that spray flows to the SFP should be maximized in the event the damage occurs prior to the recently discharged fuel being distributed.
14. The implementing guidance for the external strategy must include steps to assist the plant staff in determining whether use of the external strategy in the makeup mode is preferred, or if use in the spray mode is appropriate.
15. Capability to position the monitor nozzles internally on the spent fuel pool floor to spray into the pool for situations where the pool leakage rates and plant conditions permit this option.
16. Capability to lift/locate the monitor nozzle such that the spray can be externally directed into the spent fuel pool (e.g., from an adjacent building roof, fire truck extension ladder). The lifting capability (e.g., crane or fire truck with extension ladder) may be located off-site as long as the site has confidence (e.g., through an MOU) that it will be available for use on-site within the required timeframe (i.e., 2 hours or 5 hours). This may require a modification to the lifting device to allow the monitor nozzle to be affixed. Note: for sites with top of active fuel in the SFP that is at or below grade level, a lifting device may not be required.

<u>Response Elements</u>:

- Provide a general description of alternate SFP spray capability, including the necessary personnel actions. Description needs to include both distributed and non-distributed recently discharged fuel.
- For pools with top of active fuel above grade, describe the means to be used to direct spray on to the top of the spent fuel, if necessary (e.g., suspended platforms). See Item 2 of Additional Considerations.
- Describe the general locations of the primary equipment involved in implementing this strategy.
- Describe the general agreements or understandings with off-site resources and the provisions made for the lifting capability.
- Estimate flow rates expected to be delivered to the fuel in the SFP and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

<u>Submittal Guidance</u>:

The SFP spray capability would be employed for situations where the leakage rate exceeds the makeup rate, resulting in a drained pool. The measure would be employed by connecting hoses to the discharge of the pump and then to one or more oscillating monitor nozzles to provide a spray over the top of the pool. Conservatively, 200 gpm is a sufficient amount of spray water. For conditions following a refuel outage where recently discharged fuel from the reactor has not been dispersed to allow optimization of cooling alternatives, the implementing guidance should direct maximizing spray flow rates.

In cases where the leak rate does not significantly exceed the makeup rate, there may be sufficient time to set up the oscillating monitor nozzle on the SFP floor. As described in the external makeup strategy, similar hose arrangements could be employed. The spray provided by the nozzle is believed to provide the best cooling method for the spent fuel.

As the range of possible damage states cannot be predicted adverse environmental and radiological conditions may impose significant challenges to the mitigation response teams implementing the proposed strategy. Access to the spent fuel pool floor and its building may not be possible. It is assumed that in most situations the damage state would allow for spray into the Spent Fuel Pool through a hole caused by the event. The spray would be directed through the hole in the building by employing ladders or spraying from the roof of an adjacent building or by other means directed by the utility procedures and processes or as the event requires. Though unlikely, for those situations in which conditions and damage states do not allow spray into the pool it is not intended for the site to pre-position access points or modify containment structures to allow spray directly into the pool. For these situations spray would be directed at the point of release or on to the building. It is also recognized that unique site attributes and layouts may not allow all areas and damage states to be addressed. If inaccessibility of SFP can be anticipated in certain damage states (e.g., SFP surrounded by reinforced concrete structure and unable to spray entire pool) then indicate any immediate actions or actions that will be taken to pre-stage equipment near the SFP deck to maximize probability of spray strategy deployment. Identify the site limitations and actions in Table A.2.3 under the Notes section.

The external SFP makeup capability should be documented in the submittal using the template provided in Table A.2-3.

<u>Additional Considerations</u>:

1. For the purposes of this strategy, it should be assumed that areas immediately around the spent fuel pool and deck may not be accessible either due to damage or due to radiation levels.
2. It is understood that not all conceivable scenarios can be mitigated by sprays. The objective is for each site to work to identify means to spray the pool.

   For plants with sheet metal siding above the spent fuel pool deck, it can be always be assumed that the event sufficiently dislodged the sheet metal to allow a stream of external spray to be targeted at the spent fuel pool.

For plants that have reinforced concrete walls above the area surrounding the spent fuel pool and the top of active fuel is above grade, it is possible to envision damage scenarios where the SFP leakage occurs below the top of active fuel and an external spray through the event-induced hole would not be sufficient to provide spray distribution. In these cases, the site should investigate creative means to provide spray flow to the pool while minimizing access requirements. This may include spraying through rollup doors or building vents, or utilizing stairwells in adjacent buildings to access the spent fuel pool deck briefly to initiate sprays locally, Sites are not required to modify structures to create an access point for external sprays.

3. In cases where the reinforced concrete structure does not allow the external strategy to spray the spent fuel and the top of active fuel is above grade, the site should review the NRC's site-specific Phase 2 report to determine whether any of the RAMs identified would be beneficial for these circumstances (i.e., the RAM would provide large flowrate makeup sources or spray capability with limited or no access to the area around the spent fuel pool). The results of this review should be documented in the NOTES section of Table A.2-3.

4. While an independent pumper truck or portable pump is required to be available for implementing this strategy, the external fire protection system ring header is an acceptable water source, provided damage to the header and distribution piping in the vicinity of the spent fuel pool structure can be isolated. NOTE: Since deployment of the external makeup strategy using firewater could in many cases be quicker, if available, it can be considered as part of the strategy. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.

5. The portable pumping capability, necessary hoses, and monitor nozzles will need to be stored on-site in an area approximately 100 yards or more away from the SFP in order to assure survivability and availability for the spray function.

6. A site specific assessment of the number of spray nozzles and their locations should be performed in order to assure that 200 gpm per unit of spray is reaching the SFP and that the entire SFP is sprayed.

7. There is no need to consider the potential for equipment to be out of service for routine maintenance activities. This also means that there is no need to provide redundancy in the means of spray.
8. Equipment associated with the external strategy is not to be treated as safety-related equipment. As such, it is not subject to any new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).
9. Equipment associated with the external strategy will meet standard industry practices for procuring and maintaining commercial equipment.
10. Strategy can be implemented through guidance or procedures, consistent with the site's chosen approach. Steps are expected to be general in nature, consistent with the need for flexibility in deployment. That is, there is no need to develop scenario-specific procedures.
11. In assessing deployment times, assume access is not inhibited to the areas required for strategy implementation.
12. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.
13. It is acceptable for the portable pumping source to also be used for fire fighting (e.g., an onsite fire pumper truck).
14. It is acceptable for the portable pumping source to be periodically taken offsite (e.g., for fire fighting training). However, if the location offsite would preclude deployment within the required time, the amount of time the pump is unavailable should be limited based on site work control processes.
15. For some SFPs (e.g., elevated pools), it may be necessary to rely on a spray capability provided from offsite, it must be controlled under an MOU and can be implemented onsite within the time constraints for this strategy. In these cases, it is acceptable to use the portable onsite pump as the motive force for spray, or use a pump contained in the offsite spray equipment, or both,
16. Plants with spent fuel pools enclosed in a structure that is entirely reinforced concrete should approach this strategy in the following manner:
    a. Provide a means to spray the fuel in the SFP in the manner described above from a location external to the structure, assuming that the damage that caused loss of SFP inventory extends above top of active fuel (TAF).
    b. For cases where the postulated damage does not extend above the TAF, identify and implement alternative means to provide fuel cooling. This may include as many of the following strategies as are applicable. NOTE: These strategies should consider staging hoses, spray nozzles, etc. at various locations within the structures employing both internal and external elements to maximize the likelihood of deployment:

- Consider direct dispersement of spent fuel (in preferred configuration) discharged from the reactor during refueling outages, where possible.
- Utilizing creative means to spray from an external location (e.g., through blowout panels, doors, or building vents)
- Spray from the SFP deck, by accessing the area from an adjacent structure.
- Spray from the SFP deck, by accessing the area from all stairwells within the structure containing the SFP.
- Providing procedures/guidance to ehance air cooling of fuel in the SFP, in the event spray cooling can not be established (realize that the only time this would be required is when SFP integrity has already been compromised, such that containment of fission products cannot be assured).
- Spray the hole and/or spent fuel structure as a last resort.

17. Prior to the event, the plant systems are assumed to be in a nominal configuration with the reactor at 100% power.
18. Implementation of this strategy is not expected to require extraordinary or heroic actions. In an event, the utility emergency response organization (ERO) will decide on the potential benefit and feasibility of the strategy in light of plant conditions. For example, it is expected that dose rates and other accessibility considerations will be addressed at the time of the event, in light of the actual plant conditions. This input will be considered by the ERO in directing plant response actions.

2.4 ADDITIONAL SITE-SPECIFIC SFP MAKEUP STRATEGIES

Objective:

Retain the useful insights from the site-specific SFP mitigation assessments for reference in the event an SFP threat occurs.

Performance Attributes:

1. All NRC strategies should be reviewed to consider their viability.
2. List the viable strategies in plant procedures/guidance.

Response Elements:

- Identify which additional enhancement strategies were found to be viable.
- Confirm that procedures/guidance will, at a minimum, list the viable strategies that could be used by plant personnel (e.g., Emergency Response Organization)

Submittal Guidance:

The site-specific Phase 2 assessments performed generally identified a number of possible strategies that could enhance each site's existing capability. Many of the enhancements involved physical plant modifications. Others, however, involved minimal changes for implementation and were considered to be readily available. As such, these potential readily available enhancement strategies represent a valuable resource that would be beneficial to retain for future reference by emergency response personnel. The industry has committed to retain the viable strategies by listing them in plant procedures or guidance [Ref. 4].

The viability of each mitigation enhancement strategy should be evaluated with consideration of at least the following:

- Whether the strategy provides additional tangible makeup capability beyond that already available (e.g., a substantial fraction of 500 gpm). Thus, while potentially feasible, a strategy that provides a low makeup rate would not be considered viable.
- Whether the strategy can feasibly be accomplished with existing onsite plant equipment in the time available and plant conditions that may exist. Thus, a strategy that requires a long time to establish or requires access to many areas of the plant near and around the SFP would not be considered viable.

Each of these enhancements that are found to be viable should be identified in a plant procedure or guidance. It is sufficient to provide a list of the strategies retained. It is not necessary to specify the steps necessary for implementation.

The enhancements that will be incorporated into plant procedures/guidance should be documented in the submittal using the template provided in Table A.2-4.

2.5 LEAKAGE CONTROL STRATEGIES

Objective:

Identify for emergency response organization the on-site resources that could be used to reduce or stop leakage from a damaged spent fuel pool.

Performance Attributes:

1. There is no minimum requirement for these resources. This is simply identification of the types of existing resources that may be onsite and could be beneficial.

Response Elements:

- In general, identify the types and location of materials maintained on-site that could be used to reduce leakage rates.
- Confirm that procedures/guidance will, at a minimum, list the capabilities that may be available for use by plant personnel (e.g., Emergency Response Organization).

Submittal Guidance:

Provide a list of the typical materials that might be expected to be available onsite. Examples of typical on-site resources that might be included in such a list include:

- Plate steel
- Marine plywood
- Normal plywood
- Waterproof sealants
- Piping or lengths of lumber that could be used to shore up metal plates or plywood
- Lumber/plywood for shoring/wedges/hinged wooden plates, or
- Inflatable plugs.

The general types of leakage control capabilities should be documented in the submittal using the template provided in Table A.2-5.

Additional Considerations:

1. The purpose of this enhancement is to provide decisionmakers with a list of the types of materials that may be available and where they would be expected to be found. It is not necessary to maintain a minimum inventory of leakage control capabilities at all times. Likewise, there is no requirement to store these materials a specific distance from the target area.

3.0 REACTOR AND CONTAINMENT STRATEGIES

3.1 BACKGROUND

In June 2006, the nuclear industry proposed to enhance the mitigation capability of key safety functions associated with every operating nuclear power plant in the United States [Ref. 5]. This proposal was derived from an industry supported plant specific assessment process outlined in Reference 6, known as the Industry (Phase 3) Mitigation Strategy Study. The industry approach described in this proposal was developed by a Chief Nuclear Officer (CNO) Review Panel.

After reviewing the results of the Industry Phase 3 Studies, it became apparent to the CNO Review Panel that an approach similar to Phase 2 is appropriate and offers an efficient, as well as an effective way to achieve success, when challenged with the large spectrum of potential scenarios. While it is possible to postulate scenarios for which this proposal is not fully successful, any other reasonable approach would potentially have limited success because of the wide range of possible scenarios and outcomes as well as a high degree of uncertainty of event circumstances. Recognizing this, the CNO Panel determined that a critical feature of this proposal should be flexibility to facilitate response efforts, over a wide range of potential scenarios.

The Panel identified two critical elements of a robust industry response:

- Command and control enhancements aimed at improving initial site operational response before the Emergency Response Organization (ERO) is fully activated, and
- A specific set of mitigation strategies for all BWRs and PWRs to implement.

As part of the Industry Mitigation Strategy Study sponsored by NEI [Ref. 6], each site has developed a site-specific list of candidate enhancement strategies (CES). These strategies grew from a stylized, but structured, review of the site and existing capabilities, followed by a formal brainstorming session to identify potential candidate enhancement strategies.

Candidate enhancement strategies were identified at each plant for the following key safety functions:

BWR Safety Functions
- RPV Level Control
- Containment Isolation
- Containment Integrity
- Release Mitigation

PWR Safety Functions
- RCS Inventory Control
- RCS Heat Removal
- Containment Isolation
- Containment Integrity
- Release Mitigation

One of the major insights gleaned from this effort was that most of these CES were of relatively low confidence and would only work for very specific damage conditions and would therefore be of limited value and not worthy of expending plant resources to implement. In nearly all cases, establishing a new high confidence capability typically involved extensive plant modifications. However, similar to the conclusions of Phase 2, this exercise did identify a set of flexible, deployable generic enhancement strategies that could be beneficial in responding to a broad spectrum of damage states. Most of these involve procedure/guidance enhancements, minimal procurement, and/or very minor plant modifications to non-safety related systems. Several of the strategies rely upon the power-independent pump discussed in Section 2. It is expected that these strategies become part of the utility "toolbox" that could be used in responding to beyond design basis events. Thus, these strategies must be interfaced with existing SAMGs so that potential competing considerations associated with implementing these and other strategies are appropriately addressed.

When developing the implementing procedures/guidance for these strategies, it may be beneficial to discuss how each strategy might be useful for mitigation of other beyond design basis conditions. Utility PRA groups can evaluate the potential scenarios identified in plant-specific PRAs that may be addressed by these strategies. Thus, there may be some benefit in considering entry conditions for the implementing procedures/guidelines beyond large fires and explosions.

The CNO Panel recommended [Ref. 5] and the NRC accepted [Ref. 7] the development of enhanced command and control guidance and a total of ten mitigation strategies for BWRs and seven mitigation strategies for PWRs:

BWR Mitigation Strategies

- Manual Operation of RCIC or Isolation Condenser
- DC Power Supplies to Allow Depressurization of RPV & Injection with Portable Pump
- Utilize Feedwater and Condensate
- Makeup to Hotwell
- Makeup to CST
- Maximize CRD
- Procedure to Isolate RWCU
- Manually Open Containment Vent Lines
- Inject Water into the Drywell
- Portable Sprays

PWR Mitigation Strategies

- Makeup to RWST
- Manually Depressurize SGs to Reduce Inventory Loss
- Manual Operation of Turbine (or Diesel)-Driven AFW Pump
- Manually Depressurize SGs and Use Portable Pump
- Makeup to CST
- Containment Flooding with Portable Pump
- Portable Sprays

It should be noted that the implementation of these strategies can be considered independently. That is, there is no need to be able to concurrently implement multiple strategies. The purpose of these strategies is to provide an enhanced "toolbox" of capabilities to be used by the emergency response organization, as appropriate to the actual plant conditions. In the event the actual situation generates competing demands for the same equipment, it will be the responsibility of the emergency response organization to evaluate and choose the best use of the equipment. Additional equipment, while neither required nor expected, may be beneficial if water is to be pumped simultaneously to multiple places (e.g., to fill the steam generators from the condensate storage tank and simultaneously to refill the CST).

3.2 COMMAND AND CONTROL ENHANCEMENTS

Experience with large scale incidents has shown that command and control execution can be a key factor to mitigation success. The industry has invested extensively in establishing command and control structures for emergency conditions. However, the extent and type of damage postulated for some beyond design basis security threats may create unique challenges. Normal command and control structures may be interrupted creating implementation issues associated with procedurally required actions, communications, and organizational factors that could further complicate mitigation response for these types of postulated events.

One primary dimension of enhancing command and control for these beyond design basis conditions is providing guidance for use in such circumstances. Establishing guidelines for initial site operational response would allow utilities to "pre-think" their strategy if normal command and control is disrupted. Extensive Damage Mitigation Guidelines (EDMGs) is the generic term used by the industry introduced in Reference 6. The term, "extensive damage," is used to connote the potential for spatial impacts that are quite broad. Such damage may not only affect equipment, but may affect the ability of plant operators to monitor plant conditions and gain access to equipment in portions of the plant. In addition, due to the nature of some beyond design basis threats, it is possible to envision combinations of failures which might be considered of negligible probability in traditional severe accident analysis. Thus, the boundary conditions applied for EDMGs are substantially different from those used in defining plant operating procedures and even severe accident management guidelines (SAMGs). EDMGs are not a replacement for normal emergency operating procedures (EOPs) or SAMGs. Rather, EDMGs are developed on a plant-specific basis to allow the site to define the kinds of responses that may be appropriate in the event such conditions occurred. In the performance of the NEI sponsored site assessments, there were two types of EDMGs considered; Initial Response EDMGs and Technical Support Center (TSC) Response EDMGS. Initial Response EDMGs are the focus of the industry closure process and are described in this guidance. The strategies described in Sections 3.3 and 3.4 are not considered EDMGs and may reside in plant procedures, SAMGs, or other guidance documents, as deemed appropriate.

The scope of these Initial Response EDMGs would include:

- An assessment of on-site and off-site communication in light of potential damage to normal methods available to the ERO.
- Methods for notifications of the utility ERO/ERO activation to mobilize additional resources to the site in a timely manner

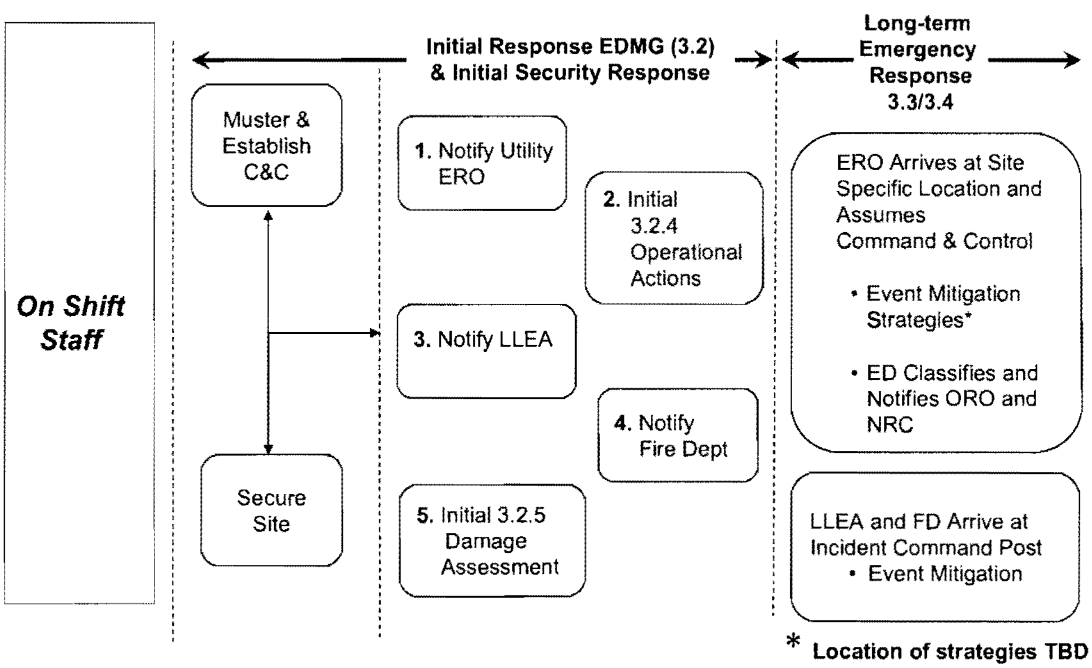
- Basic initial response actions needed to potentially stabilize the situation or delay event degradation, including key mitigation strategies to help manage critical safety functions in the near term.
- Initial damage assessment to provide the ERO with information on plant damage conditions and status, as feasible.

The initial response EDMGs are not a type of emergency operating procedures (EOPs), nor are they intended to be a replacement for EOPs. They are, in fact, intended to be used when the normal command and control structure is disabled and use of EOPs is not feasible.

The initial response EDMGs are intended to provide a bridge between normal operational command and control and the command and control that is provided by the emergency response organization. The relationship between the initial response EDMGs, the initial security response, and other long-term response actions is shown below in Figure 3-1.

Figure 3-1

Initial Response EDMG Flowchart



3.2.1 Boundary Conditions

The purpose of the initial response EDMGs is to define the actions to be taken in the event normal procedures and/or command and control structures are not available. The entry conditions for this EDMG might include loss of plant control and monitoring capability due to a large explosive or fire. This could take the form of damage to the control room and alternate shutdown capabilities, or loss of all AC and DC power, or all of these. An example of such a condition might involve a large fire or explosion that affected the main control room, control room personnel, and alternate shutdown capability. In such a condition, it is possible that remote instrumentation may not be available and the availability of main control room personnel may be in question. In such a condition, a number of immediate actions could be required, without the benefit of normal command and control functions.

For the purposes of developing the initial response EDMGs, the following basic assumptions should be utilized:

1. Imminent threat warning does not occur.
2. Loss of access to the control room.
3. Loss of any equipment/supplies normally located in the control room and/or the building housing the control room.
4. Loss of access to the building containing the control room.
5. Loss of all personnel normally in the control room.
6. Loss of all AC and DC power required for operation of plant systems (i.e., both 1E and non-1E sources).
7. Minimum site staffing levels (i.e., weekend/back shift)
8. Other on-site control rooms and personnel in separated buildings are unaffected.
9. Operations personnel not normally located in the control building can be assumed to be available for EDMG implementation. This includes auxiliary operators that may, from to time, be in the control building for shift turnover, briefs, or breaks. There is no requirement for a minimum number of personnel to be maintained outside of the control building to support EDMG implementation. The assumption of availability should be based on nominal personnel locations based on their operational assignments, not bounding assumptions about the potential for periodic co-location of personnel.
10. Actions taken can be by non-licensed personnel, typically an auxiliary operator.
11. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.

12. Prior to the event, the plant systems are in a nominal configuration with the reactor at 100% power.

One of the difficult aspects of enhancing command and control for beyond design basis conditions is balancing the need to be prepared with the potential for widespread damage. It is always possible to postulate worse damage conditions. Likewise, it is possible to postulate lesser damage. The purpose of the above assumptions is to frame the problem. If one of these beyond design basis events ever occurs, the plant staff and the equipment will respond (both operationally and systemically) to the best of their/its ability. The goal of this effort is to provide the plant staff with additional capabilities that could provide benefit. While these assumptions frame the situation, it would be inappropriate to assume that plant would always be in such a condition. Thus, utilities are encouraged to look for creative ways to achieve success while relying on minimal staff and command and control capabilities.

3.2.2 Off-Site and On-Site Communications

<u>Objective</u>:

Improve the initial response of the available plant operational resources and enhance the capability for those resources to communicate with off-site resources.

<u>Performance Attributes</u>:

1. Establish a mustering location to organize available resources.
2. Establish pre-plans for on-site and off-site communications.
3. Establish a means to coordinate operations and security responses.
4. Identify communication resources given postulated widespread damage to each key plant structure.

<u>Response Elements</u>:

- Describe the diverse methods available to communicate with off-site personnel that could be effective for the conditions assumed.
- Describe the approach for mustering the available plant resources in the event the control room/staff are substantially affected.
- Describe Operations/Security pre-plans for re-establishment of communications immediately following a large fire or explosion.
- Describe how operations and security personnel will coordinate activities immediately following a large fire or explosion.

Submittal Guidance:

The B.5.b Phase 1 effort included elements related to communications. In addition, the site-specific Phase 3 assessments performed by NEI generally included a more explicit consideration of the potential impacts of large fires and explosions on the communications capability of each site.

The onsite and offsite communications capabilities should be documented in the submittal using the template provided in Table A.3-1.

Additional Considerations:

1. The example EDMG templates provided in Appendix C provide a tabular format for documenting the communications methods and potential impacts of large explosions and fires in specific buildings on those capabilities.
2. Under the postulated conditions, traditional communications assets may become overloaded, so identify various diverse methods to provide increased confidence in communications.

3.2.3 Notifications/ERO Activation

Objective:

The postulated damage to the command and control structure makes early notification of the utility emergency response organization (ERO) and ERO callout of great importance. This aspect of the initial response EDMGs is intended to provide an enhanced level of assurance that the proper notifications of the utility ERO occur and the ERO callout is initiated in a timely manner, despite the postulated condition.

Performance Attributes:

1. Define the command and control structure given the postulated damage and potential for casualties affecting normal command and control.
2. Define how command and control will be established given the postulated damage to the command and control structure.
3. Establish guidance for offsite notifications of the utility ERO and ERO callout using minimal personnel outside the remaining unaffected staff, given the postulated damage and potential for casualties

Response Elements:

- Describe the command and control structure that will be established prior to arrival of offsite resources, in the event the control room/staff are substantially affected

- Describe the approach(es) for making the appropriate off-site notifications of the utility ERO and ERO callout in the event the control room/staff are substantially affected
- Confirm that a procedure/guidance and training will be developed for ERO and personnel expected to make notifications to the utility ERO.

Submittal Guidance:

The B.5.b Phase 1 effort included elements related to command and control. In addition, the site-specific Phase 3 assessments performed by NEI generally included a more explicit consideration of the potential impacts of large fires and explosions on the command and control capability of each site.

The command and control capabilities should be documented in the submittal using the template provided in Table A.3-1.

Additional Considerations:

1. Consider identification of multiple (alternate) personnel who have appropriate knowledge, skills, and abilities that may not be affected by damage state. This may include use of personnel from adjacent units, or qualified personnel that are normally in physically separated work locations.
2. Consider alternate personnel outside the of control room/staff (e.g., security personnel) to perform notifications of the utility ERO given certain entry criteria (i.e., large explosion or fire).

3.2.4 Initial Operational Response Actions

Objective:

Early actions to assure core cooling can minimize the potential for core damage or can assist in significantly delaying damage timelines. Given the potentially limited on-site resources, it is important to focus on the key actions that may be able to prevent or delay a release as well as be reasonably accomplished in adverse conditions.

Performance Attributes:

1. Minimum PWR Actions:
   - Attempt to confirm reactor scram
   - Attempt to confirm start and injection of at least one AFW pump into at least one SG
2. Minimum BWR Actions:
   - Attempt to confirm reactor scram

- Attempt to confirm start and injection of RCIC into the RPV, or isolation condenser operation

Response Elements:

- Describe the entry conditions for the procedure/guidance on initial operation response actions
- Provide a general description of the initial operational response actions
- Describe the general locations of the primary equipment involved in implementing these actions
- Confirm that a procedure/guidance and training will be developed for initial operations response actions

Submittal Guidance:

The site-specific Phase 3 assessments performed by NEI generally included explicit consideration of the initial operational responses to large fires and explosions for each site. The specific approach to be taken in the development of guidance for the initial operational response actions is necessarily site-specific. The guidance must be developed in accordance with site procedures and practices and interfaced with the appropriate implementing procedures. The initial operational response actions should be summarized in the submittal using the template provided in Table A.3-1.

Additional Considerations:

1. The example EDMG templates provided in Appendix C provide a general format and content for documenting the initial operational response actions. These generalized formats were adapted from site-specific guidance collected in the NEI Phase 3 work and are provided as examples only. There is no requirement to utilize these formats. Appendix C.1 includes procedure-style guidance typical of many PWRs. Appendix C.2 includes flowchart style guidance typical of many BWRs.
2. There is no need to submit the actual procedures as part of this submittal.
3. It is the intent of this effort to make use of existing personnel. There is no intent or expectation that plants will add on-shift personnel.
4. The resulting procedure/guideline should be written knowing that limited personnel resources may exist, but they should also consider that additional resources may be available.

3.2.5 Initial Damage Assessment

Objective:

In the postulated conditions, normal instrumentation may not be available. The purpose of this aspect of the initial response EDMGs is to utilize the available onsite resources to perform an assessment of the plant and equipment conditions in order to assist the arriving ERO personnel in decision-making and development of specific strategies.

Performance Attributes:

1. Condition of reactor and core cooling systems.
2. Condition of containment.
3. Condition of ECCS equipment.
4. Condition of key support systems (AC/DC power, cooling water, air, etc.).
5. Condition and accessibility of key buildings.

Response Elements:

- Provide a general description of the damage assessment to be provided to the ERO.
- Confirm that a procedure/guidance and training will be developed for initial damage assessments.

Submittal Guidance:

The specific approach to be taken in the development of guidance for the initial damage assessment is necessarily site-specific. The guidance must be developed in accordance with site procedures and practices and interfaced with the appropriate implementing procedures. The initial damage assessment should be summarized in the submittal using the template provided in Table A.3-1.

Additional Considerations:

1. The example EDMG templates provided in Appendix C provide a general format and content for documenting the initial damage assessment. These generalized formats were adapted from site-specific guidance collected in the NEI Phase 3 work and are provided as examples only. There is no requirement to utilize these formats. Appendix C.1 includes procedure-style guidance typical of many PWRs. Appendix C.2 includes flowchart style guidance typical of many BWRs.

3.3 ENHANCED SITE RESPONSE STRATEGIES FOR PWRS

A total of seven PWR reactor and containment mitigation strategies have been identified for sites to implement. In some cases, the site will already have implemented an acceptable mitigation strategy. In other cases, additional effort such as procedure/guidance enhancements, minimal procurement, and/or very minor plant modifications will be required. These strategies are not considered EDMGs. Rather, they are strategies that are to be established for plant use at each plant. They may be implemented using plant procedures, SAMGs, or other guidance documents, as deemed appropriate.

General Guidance on Strategies:

1. Unlike the initial response EDMGs discussed above, for the purposes of implementing these strategies, it can be assumed that the normal command and control structure is in-place and functioning.
2. There is no need to consider the potential for equipment to be out of service for routine maintenance activities. This also means that there is no need to provide redundant strategies.
3. Equipment associated with these strategies is not to be treated as safety-related equipment. As such, it is not subject to any of new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).
4. Equipment associated with these strategies will meet standard industry practices for procuring and maintaining commercial equipment.
5. These strategies can be implemented through guidance or procedures, consistent with the site's chosen approach. Steps are expected to be general in nature, consistent with the need for flexibility in deployment. That is, there is no need to develop scenario-specific procedures.
6. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.
7. It is not necessary to consider the EDMG boundary conditions (Section 3.2.1) when devising approaches to these specific strategies. Rather, the general boundary conditions are described for each strategy under the heading of Additional Considerations. In many cases, the implied damage conditions which drive these strategies involve a loss of internal power distribution (LIPD). For cases involving an assumed LIPD condition, the strategies would be implemented without any off-site or on-site AC or DC power.
8. Borated or treated water sources, although preferable in some conditions, are not required. The objective is to provide water from available water source for cooling.

9. These strategies should be interfaced with existing SAMGs so that potential competing considerations associated with implementing these and other strategies are appropriately addressed.
10. Prior to the event, the plant systems are assumed to be in a nominal configuration with the reactor at 100% power.
11. Implementation of the strategies is not expected to require extraordinary or heroic actions. In an event, the utility emergency response organization (ERO) will decide on the potential benefit and feasibility of the strategy in light of plant conditions. For example, it is expected that dose rates and other accessibility considerations will be addressed at the time of the event, in light of the actual plant conditions. This input will be considered by the ERO in directing plant response actions.

3.3.1 Makeup to RWST

Objective:

Provide a large volume makeup source to the reactor water storage tank (or equivalent) in order to supply ECCS long-term.

Performance Attributes:

1. Provide a means to makeup at least 300 gpm of water to the RWST for a period of 12 hours. This could utilize the Phase 2 pump, or other existing sources. On a site-specific basis, makeup rate of less than 300 gpm can be justified.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how the RWST refill will be accomplished.
- Describe the general locations of the primary equipment involved in refilling the RWST.
- Estimate flow rates expected to be delivered to the RWST and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

It is possible to postulate damage to containment that could affect ECCS recirculation capability. This strategy is aimed at providing a source of makeup to the RWST in order to provide an extended supply of water for core cooling.

The RWST makeup capability should be documented in the submittal using the template provided in Table A.4-1.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas immediately around the RWST will be accessible.
2. Since makeup would only be needed in the event the ECCS pumps are operating, it is reasonable to assume that 1E electrical power is available.
3. While makeup with borated water is preferable, it is not required. Consistent with PWR SAMGs, the use of unborated water for ECCS injection is preferable over having no water for ECCS injection.
4. In implementing this strategy, the fire protection system may be used provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities. It is recognized that fire system at many sites is the most flexible system that can be employed to mitigate many of the element associated with this effort. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.
5. If a portable pumping capability is relied upon, the pump and necessary hoses will need to be stored on-site in an area approximately 100 yards or more away from the target area in order to assure survivability.
6. On a site-specific basis, plants may justify an RWST makeup rate of less than 300 gpm. The makeup rate must be 100 gpm greater than the rate necessary to remove decay heat by boiling in the RCS.
7. The purpose of this strategy is to provide a means to provide a water supply to an operating ECCS pump. Therefore, makeup may be provided directly to the ECCS suction line or the RWST. If makeup is provided to the ECCS pump, the hoses and connections may be stored locally at the intended connection point.

3.3.2 Manually Depressurize SGs to Reduce Inventory Loss

Objective:

Provide a power-independent means to depressurize steam generators by locally manually opening atmospheric dump valves (or SGs PORVs) in order to reduce SG pressure and RCS temperature/ pressure.

Performance Attributes:

1. Many plants already have procedures/guidance for station blackout conditions.
2. Confirm availability of procedures/guidance.
3. Confirm availability of any necessary supplies either in the local area where action would be taken or in an area that is physically separate from the Auxiliary, Turbine and Control Buildings (e.g., in an on-site warehouse).

Response Elements:

- Provide a general description of how the Steam Generators will be depressurized.
- If relying on an existing procedure for this action, confirm applicability to the postulated conditions.
- Describe the general locations of the primary equipment involved in implementing the strategy.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

This strategy has two benefits. First, the depressurization of SGs will, in turn, reduce RCS temperature and pressure. This will reduce RCS leakage and reduce the stresses on RCP seals. The second potential benefit is that depressurization of the SGs will allow other low pressure makeup sources to support decay heat removal (See Section 3.3.4).

Many plants already have procedures that address this strategy. For example, the Emergency Contingency Actions for Westinghouse plants generally address this in ECA 0.0 for Station Blackout conditions. For those plants, this may be largely a confirmation. However, there are two potentially unique considerations for this condition: (1) DC power is assumed to be unavailable and (2) plants should evaluate the location of any equipment necessary to accomplish the SG depressurization.

The steam generator depressurization capability should be documented in the submittal using the template provided in Table A.4-2.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas immediately around the steam generator relief valves and atmospheric dump valves will be accessible.
2. Any equipment (e.g., air bottles, cheater bars, etc.) necessary to support depressurization of the steam generators should either be stored in the vicinity of the location where the action must be taken, or in an area well removed from that location (e.g., a warehouse) so that access to other parts of the plant structure is not required.
3. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available.
4. The procedure/guidance for implementation of this strategy should consider potential controls on degree and rate of SG depressurization. In addition, guidance should address reclosure of the SG ADVs/PORVs in the event core damage is imminent in order to prevent a challenge to SG tube integrity.

3.3.3 Manual Operation of Turbine-Driven (or diesel-driven) AFW Pump

Objective:

Provide a power-independent means to provide core cooling and prevent or delay core damage.

Performance Attributes:

1. Provide a procedure/guidance that describes the plant-specific steps necessary to start and operate an AFW pump without AC or DC power.
2. Identify a means for reasonably managing SG level using available, non-powered instrumentation and/or operator aids such as a pressure-flow curve.

Response Elements:

- Provide a general description of how the manual operation of the AFW pump will be accomplished.
- Describe the general locations of the primary equipment involved in implementing the strategy, including any valves that must be manipulated.

- Estimate flow rates expected to be delivered to the SGs and identify the capacity of water supplies.
- Describe any non-powered instrumentation or operator aids that will be used to manage SG level.
- Confirm that a procedure/guidance will be developed for implementing this strategy prior to SG dryout.

Submittal Guidance:

This strategy is one part of the EDMGs discussed in Section 3.2. Many plants already have procedures to start and run turbine-driven or diesel-driven AFW pumps without AC or DC power. One difference in this strategy is the focus on plant operators being able to reasonably manage SG level without AC and DC power.

The capability to manually operate AFW should be documented in the submittal using the template provided in Table A.4-3.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas immediately around the AFW pump will be accessible at the time the pump needs to be started. In developing the procedures/guidance and operator aids, consideration should be given to the potential accessibility of the pump rooms after extended operation without AC or DC power (e.g., without room cooling).
2. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available.
3. The Initial Response EDMGs will address this strategy as an immediate action
4. Control of the makeup rate to the steam generator(s) needs to be considered. Operator aids to assist in setting and controlling SG makeup to prevent overfill or underfeed conditions should be developed. There is a significant volume in the SGs, and precise control of SG level is not required. However, overfill can lead to damage of steamline piping and/or tripping of a turbine-driven AFW pump. Likewise, under-filling the SGs can lead to RCS heat up and eventual core damage, if not protected against. Depending on plant capabilities, the potential options for these aids might include:

    - Existing non-powered instrumentation,
    - Procedures for directly reading SG level at the instrumentation penetration to containment,
    - Strap-on flow meters,

- Operator aids based on pump flow curves, or
- Operator aids based on CST depletion rates

5. The goal of this strategy is to enhance the likelihood of long-term operation of the pump and control of SG level. However, it is understood that this may not be feasible for some plants. Just starting a turbine-driven pump and letting it run to overfill can provide a significant delay in the progression of events. Thus, there is no specific requirement for how long SG level control can be assured.

3.3.4 Manually Depressurize SGs and Use Portable Pump

Objective:

Utilize Strategy #2 (Section 3.3.2) in combination with a low pressure makeup source to provide SG makeup and core cooling.

Performance Attributes:

1. Provide a means to makeup at least 200 gpm of water to the SG for a period of 12 hours. A makeup rate of less than 200 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how the portable pump will be used to provide SG feed.
- Describe the general locations of the primary equipment involved this strategy, including any valves that must be manipulated.
- Estimate flow rates expected to be delivered to the SGs and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

This strategy is intended to be a backup to the use of the AFW system.

The steam generator depressurization and portable pump capability should be documented in the submittal using the template provided in Table A.4-4.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas immediately around the turbine-driven or diesel-driven AFW pump will be inaccessible (otherwise, AFW would be used for decay heat removal). Thus, the preferred location for any hose connections would be in areas of the plant as far away from the AFW system as possible. However, if the only feasible locations are on the AFW system, the connections should normally be as far away as possible from the AFW pump vicinity. Areas required to manually depressurize the SGs can be assumed to be accessible (per Section 3.3.2).
2. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available to support the operation of the pump and manipulation of valves. However, it can be assumed that some sort of SG cooling has been available for some time in order to allow this strategy to be deployed (e.g., manual operation of the TDAFW pump was successful for some time). Furthermore, it can be assumed that the cooldown of the RCS and depressurization of the SGs was initiated during this period.
3. This strategy could utilize the Phase 2 pump, or other existing portable pumping sources. The fire protection system may be used as a water source to the pump provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities. The connections could be accomplished by making use of vent and drain lines or other existing connection points on systems connected to SG makeup systems, or by providing a replacement valve bonnet that would have a flange/connector capable of accepting one or more hoses.
4. Even when depressurized, SG pressure may remain somewhat elevated in order for decay heat to be rejected via the SG PORVs/ADVs. The SG pressure will be a function of the number of SGs depressurized and fed, the number of SG PORVs/ADVs opened, and the relative size of the SG PORVs/ADVs. Typically, the required SG pressure will be much less than 100 psig. The portable pump and hose arrangement must be capable of providing the required flow at such pressures, including consideration of line losses which may be significant, depending on the routing. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation.
5. On a site-specific basis, plants may justify an SG makeup rate of less than 200 gpm. The makeup rate must be at least the rate necessary to remove decay heat from the RCS.
6. The procedure/guidance for implementation of this strategy should consider potential controls on degree and rate of SG depressurization.

7. Impementing guidance should address reclosure of the SG ADVs/PORVs in the event core damage is imminent in order to prevent a challenge to SG tube integrity.

3.3.5 Makeup to CST/AFWST

Objective:

Provide a high volume makeup source to the condensate storage tank (CST)/auxiliary feedwater storage tank (AFWST) in order to supply AFW long-term.

Performance Attributes:

1. Provide a means to makeup at least 200 gpm of water to the CST/AFWST for a period of 12 hours. This could utilize the Phase 2 pump, or other existing sources. A makeup rate of less than 200 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how the CST/AFWST refill will be accomplished.
- Describe the general locations of the primary equipment involved in this strategy.
- Estimate flow rates expected to be delivered to the CST/AFWST and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

It is possible to postulate damage that could affect normal CST/AFWST makeup capability. This strategy is aimed at providing a source of makeup to the CST/AFWST in order to provide an extended supply of water for secondary cooling.

The CST/AFWST makeup capability should be documented in the submittal using the template provided in Table A.4-5.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas immediately around the CST/AFWST will be accessible.
2. Since manual operation of an AFW pump could allow SG makeup without AC or DC power, the implementation of this strategy should assume that

this is a LIPD condition and there is no on-site or off-site AC or DC power available.

3. While makeup with clean sources of water is preferable, it is not required.

4. In implementing this strategy, the site should assume that the fire protection system may be used provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities. It is recognized that fire system at many sites is the most flexible system that can be employed to mitigate many of the element associated with this effort. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.

5. If a portable pumping capability is relied upon, the pump and necessary hoses will need to be stored on-site in an area approximately 100 yards or more away from the target area in order to assure survivability and availability for the CST/AFWST refill function.

6. Each site should consider that this makeup capability can be implemented prior to steam generator dryout following depletion of the CST/AFWST, assuming that the CST/AFWST is the only water available to remove decay heat.

7. On a site-specific basis, plants may justify a CST/AFWST makeup rate of less than 200 gpm. The makeup rate must be at least the rate necessary to remove decay heat from the RCS.

8. The purpose of this strategy is to provide a means to provide a water supply to an operating AFW pump. Therefore, makeup may be provided directly to the AFW suction line or the CST/AFWST. If makeup is provided to the AFW pump, the hoses and connections may be stored locally at the intended connection point.

3.3.6 Containment Flooding with Portable Pump

Objective:

Provide a power-independent means to inject water into the containment to flood the containment floor and cover core debris.

Performance Attributes:

1. Provide a means to makeup at least 300 gpm of water to the containment for a period of 12 hours. A makeup rate of less than 300 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how the portable pump will be used to flood containment.
- Describe the general locations of the primary equipment involved in flooding containment with the portable pump, including any valves that must be manipulated.
- Estimate flow rates expected to be delivered to the containment and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

This strategy is intended to be a backup to the use of the containment spray or ECCS injection systems.

The capability to flood containment using a portable pump should be documented in the submittal using the template provided in Table A.4-6.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that this is a LIPD condition and there is no onsite or offsite AC or DC power available.
2. Since the objective is to put water into the containment in order to flood the core debris after vessel failure, the injection can be routed through the containment spray system, ECCS injection systems, or any other system that can route the water into the containment. This strategy could utilize the Phase 2 pump, or other existing portable pumping sources. The connections could be accomplished by making use of vent and drain lines or

other existing connection points on systems, or by providing a replacement valve bonnet that would have a flange/connector capable of accepting one or more hoses.

3. Containment pressure may be elevated (~design pressure), so the portable pump must be capable of providing the required flow at such pressures, including consideration of line losses which may be significant, depending on the routing. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation

4. The portable pumping capability and necessary hoses will need to be stored on-site in an area approximately 100 yards or more away from the target area in order to assure survivability and availability for the containment flooding function.

5. In implementing this strategy, the fire protection system may be used provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and spray capabilities.

6. On a site-specific basis, plants may justify a makeup rate to the containment of less than 300 gpm. The makeup rate must be at least 100 gpm greater than the rate necessary to remove decay heat from the RCS.

3.3.7 Portable Sprays

<u>Objective</u>:

Provide a means to reduce the magnitude of any fission product releases by spraying

<u>Performance Attributes</u>:

1. Provide procedure/guidance on use of the portable spray capability provided for SFP mitigation in the event of a release from the Containment/Auxiliary Building.

<u>Response Elements</u>:

- Provide a general description of how the portable pump will be used to spray a radiological release including a description of portions of affected plant structures that cannot be sprayed due to physical layout or equipment limitations. This is intended to be a qualitative description of the portions of structures that are expected to be sprayable <u>assuming there are no accessibility constraints</u>.
- Describe the general locations of the primary equipment involved in use of portable sprays.

- Estimate spray flow rates expected to be delivered and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

The purpose of these sprays is to mitigate any release of fission products from the containment.

The capability to spray containment using a portable pump should be documented in the submittal using the template provided in Table A.4-7.

Additional Considerations:

1. The purpose of this strategy is to spray a release coming from a damaged or failed containment. For the purposes of this strategy, it should be assumed that areas immediately around the containment will be accessible.
2. In implementing this strategy, consideration should be given to containing the runoff from the sprays. This may include providing a means to close off storm drains and/or providing materials to route runoff to a desired area. Guidance on deployment of the sprays should consider the amount of spray water that can be contained.
3. In implementing this strategy, the fire protection system may be used as a water source to the pump provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup spray capabilities. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.
4. The portable pumping capability, necessary hoses, and monitor nozzles will need to be stored on-site in an area away from the containment in order to assure survivability and availability for the spray function. In general, storage of equipment should be approximately 100 yards or more from the target area.

5. Utility PRA personnel can be consulted to identify the more likely release points from containment. These should be considered when specifying the spray nozzles and pumping capability. Releases that occur through a containment vent or through the site elevated release point are not expected to be sprayed.
6. In the event spray is to be used to mitigate a release, the implementing procedure/guideline should direct the spray flow rate be maximized to the extent the spray water can be contained. However, this does not imply that spray should/would be terminated in a real event simply because the capability to contain spray runoff is exceeded. In a real event, such decisions would be made by the ERO, based on the actual conditions.

3.4 ENHANCED SITE RESPONSE STRATEGIES FOR BWRs

A total of ten BWR reactor and containment mitigation strategies have been identified for sites to implement. In some cases, the site will already have implemented an acceptable mitigation strategy. In other cases, additional effort such as procedure/guidance enhancements, minimal procurement, and/or very minor plant modifications will be required. These strategies are not considered EDMGs. Rather, they are strategies that are to be established for plant use at each plant. They may be implemented using plant procedures, SAMGs, or other guidance documents, as deemed appropriate.

<u>General Guidance on Strategies</u>:

1. Unlike the initial response EDMGs discussed above, for the purposes of devising implementation approaches for these strategies, it can be assumed that the normal command and control structure is in-place and functioning.
2. There is no need to consider the potential for equipment to be out of service for routine maintenance activities. This also means that there is no need to provide redundancy.
3. Equipment associated with these strategies is not to be treated as safety-related equipment. As such, it is not subject to any new special treatment requirements under 10 CFR (e.g., QA, seismic, EQ, etc.).
4. Equipment associated with these strategies will meet standard industry practices for procuring and maintaining commercial equipment.
5. These strategies can be implemented through guidance or procedures, consistent with the site's chosen approach. Steps are expected to be general in nature, consistent with the need for flexibility in deployment. That is, there is no need to develop scenario-specific procedures.
6. Level of training on implementing procedures/guidance is expected to be consistent with SAMG-type actions and consistent with utility commitments made under B.5.b Phase 1.

7. For each strategy, the general boundary conditions are described. In many cases, the implied damage conditions which drive these strategies involve a loss of internal power distribution (LIPD). For cases involving an assumed LIPD condition, the strategies would be implemented without any off-site or on-site AC or DC power.
8. These strategies should be interfaced with existing SAMGs so that potential competing considerations associated with implementing these and other strategies are appropriately addressed.
9. Prior to the event, the plant systems are assumed to be in a nominal configuration with the reactor at 100% power.
10. Implementation of the strategies is not expected to require extraordinary or heroic actions. In an event, the utility emergency response organization (ERO) will decide on the potential benefit and feasibility of the strategy in light of plant conditions. For example, it is expected that dose rates and other accessibility considerations will be addressed at the time of the event, in light of the actual plant conditions. This input will be considered by the ERO in directing plant response actions.

3.4.1 Manual Operation of RCIC or Isolation Condenser

Objective:

Provide a power-independent means to provide core cooling and prevent or delay core damage.

Performance Attributes:

1. Provide a procedure/guidance that describes the plant-specific steps necessary to start and operate RCIC or the Isolation Condenser without AC or DC power.
2. Identify a means for reasonably managing RPV level using available, non-powered instrumentation and/or operator aids such as a pressure-flow curve.

Response Elements:

- Provide a general description of how the manual operation of RCIC or the Isolation Condenser will be accomplished.
- Describe the general locations of the primary equipment involved in manually operating RCIC/IC, including any valves that must be manipulated.
- For RCIC:
  - estimate flow rates expected to be delivered to the RPV and identify the capacity of water supplies, and

  - Describe any non-powered instrumentation or operator aids that will be used to manage RPV level.
- For isolation condensers (IC),
  - Provide the time to loss of effectiveness of the IC without makeup, and
  - Describe any non-powered instrumentation or operator aids that will be used to manage shell side IC water level.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

<u>Submittal Guidance</u>:

This strategy is one part of the Initial Response EDMGs discussed in Section 3.2. Many plants already have procedures to start and run RCIC or the IC without AC or DC power. One difference in this strategy is the focus on plant operators being able to reasonably manage RPV (or IC) level without AC and DC power.

The capability to manually operate RCIC or the IC should be documented in the submittal using the template provided in Table A.5-1.

<u>Additional Considerations</u>:

1. For the purposes of this strategy, it should be assumed that Reactor Building will be accessible at the time the pump needs to be started/IC needs to be initiated. In developing the procedures/guidance and operator aids, consideration should be given to the potential accessibility of the RCIC pump room or areas of the plant required to be accessed after extended operation without AC or DC power (e.g., without room or area cooling).
2. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available.
3. The Initial Response EDMGs will also address this strategy as an immediate action

4. For RCIC, control of the makeup rate to the RPV needs to be considered. Monitoring of reactor water level with local instrumentation or operator aids to assist in setting and controlling RPV level to prevent overfill or underfeed conditions should be developed. There is a significant volume in the RPV, and precise control of RPV level is not required. However, overfill can lead to damage of steamline piping and/or the RCIC pump. Likewise, under-filling the RPV can lead to core uncovery and eventual core damage, if not protected against. Depending on plant capabilities, the potential options for these aids might include:

   - Existing non-powered instrumentation (e.g., Yarways, if available),

- Procedures for directly reading RPV level at the instrumentation penetration to containment,
- Strap-on flow meters,
- Operator aids based on pump flow curves, or
- Operator aids based on CST depletion rates.

5. For ICs, make up to the IC shell side needs to be provided in the LIPD condition. This may include use of the portable pump and hoses.

6. For ICs, monitoring of reactor water level with local instrumentation should be considered. Depending on plant capabilities, the potential options for these aids might include:

   - Existing non-powered instrumentation (e.g., Yarways, if available),
   - Procedures for directly reading RPV level at the instrumentation penetration to containment,

7. The goal of this strategy is to enhance the likelihood of long-term operation of the pump and control of RPV level control system (RCIC or IC). However, it is understood that this may not be feasible for some plants. In the case of RCIC, just starting a turbine-driven pump and letting it run to overfill can provide a significant delay in the progression of events or in the case of ICs, just using the available cooling without make up can delay the progression of events. Thus, there is no specific requirement for how long RPV level control can be assured.

3.4.2 DC Power Supplies to Allow Depressurization of RPV and Injection with Portable Pump

Objective:

Provide a means to depressurize the RPV and provide makeup with low pressure systems or the portable pump provided under the Phase 2 closure process.

Performance Attributes:

1. Provide a means to locally energize SRV solenoids at the appropriate containment penetration(s). The number of SRVs to be energized should be sufficient to depressurize the RPV below the shutoff head of low pressure pumps (LPCI or LPCS) at decay heat levels.
2. Identify existing connection points for the Phase 2 portable pump to provide makeup to the RPV. This could be accomplished by making use of vent and drain lines or other existing connection points on systems connected to

RPV injection systems, or by providing a replacement valve bonnet that would have a flange/connector capable of accepting one or more fire hoses.

3. Provide a means to makeup at least 300 gpm of water to the RPV for a period of 12 hours. This could utilize the Phase 2 pump, or other existing sources. A makeup rate of less than 300 gpm may be justified on a site-specific basis.
4. Provide procedure/guidance for implementation of this strategy.

Response Elements:

- Provide a general description of how the RPV will be depressurized using portable DC power supplies and how the portable pump will be used to provide RPV injection.
- Describe the general locations of the primary equipment involved in implementing this strategy, including any valves that must be manipulated.
- Estimate flow rates expected to be delivered to the RPV and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

Loss of power conditions can inhibit the ability to depressurize the RPV to gain access to low pressure RPV makeup systems. The goal of this strategy is to provide a flexible means to depressurize the RPV and in order to use the portable pumping capability to provide RPV makeup.

In general, this would be expected to involve creating the capability to locally energizing the ADS/SRV solenoid valves at the containment penetration. This would require a portable DC power supply. This could be accomplished by providing a dolly capable of transporting and connecting multiple vehicle batteries to various locations or by utilizing a portable AC power supply with a rectifier.

The capability to depressurize and inject to the RPV should be documented in the submittal using the template provided in Table A.5-2.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that Reactor Building will be accessible.
2. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available. Spatially separated batteries from another unit could also be considered. However, if power is to be supplied from another unit, it should be provided

from a location that is sufficiently spatially separated from the normal power supply and cable routing to provide confidence that the alternate power will be available.

3. Given access to the Reactor Building, it can be assumed that the strategy for manually operating RCIC (Section 3.5.3) is also viable. This provides additional time for this strategy to be implemented.

4. This strategy could utilize the Phase 2 pump, or other existing portable pumping sources. The connections could be accomplished by making use of vent and drain lines or other existing connection points on systems, or by providing a replacement valve bonnet that would have a flange/connector capable of accepting one or more hoses.

5. RPV pressure and decay heat profiles should be reviewed to determine what the portable pump must be capable of in order to provide the required flow. Include consideration of line losses which may be significant, depending on the routing. The minimum debris retention injection rate should be considered to determine required flow rates. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation.

6. The portable pumping capability, necessary hoses, and portable power supplies will need to be either stored in the vicinity of where they will be used or elsewhere on-site in an area at approximately 100 yards or more away from the target area, in order to assure survivability and availability for RPV injection.

7. Depending on the implementation, the approach taken to aligning the RPV makeup may also suffice for drywell flooding (Section 3.4.9)

8. A flowrate of 300 gpm is expected. However, under some circumstances, exceptions may be justified down to an RPV injection rate of 200 gpm. Examples of potential justifications which may be considered by the NRC include cases where costly plant modifications are required to achieve 300 gpm, implementation of the higher RPV makeup strategy would be substantially delayed injection, or substantially higher level of confidence can be established for a flowrate between 200 and 300 gpm.

9. Energizing the SRV solenoids from a location other than the containment penetration(s) may be acceptable. However, since cabling can be compromised by the large fire or explosion, it is preferable to energize them as close to the penetration as practical. If the SRV solenoids are energized remote from the containment penetration, a justification should be provided in the Notes section of Table A.5-2, for consideration by the NRC.

3.4.3 Utilize Feedwater and Condensate

Objective:

Provide a means to makeup to RPV from a source external from the Reactor Building.

Performance Attributes:

1. All BWRs already include this strategy in EOPs.

Response Elements:

No specific response required.

3.4.4 Makeup to Hotwell

Objective:

Provide a high volume makeup source to the hotwell in order to supply FW/condensate long-term.

Performance Attributes:

1. Provide a means to makeup at least 300 gpm of water to the condenser hotwell for a period of 12 hours. This could utilize the Phase 2 pump, or other existing sources. A makeup rate of less than 300 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how makeup to the hotwell will be accomplished.
- Describe the general locations of the primary equipment involved in makeup to the hotwell.
- Estimate flow rates expected to be delivered to the hotwell and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

It is possible to postulate damage to the plant that could affect RPV makeup using ECCS systems. This strategy is aimed at providing a source of makeup to the hotwell in order to provide an extended supply of water for RPV makeup by the feedwater and/or condensate systems.

The hotwell makeup capability should be documented in the submittal using the template provided in Table A.5-4.

<u>Additional Considerations</u>:

1. For the purposes of this strategy, it should be assumed that areas immediately around the condenser and hotwell will be accessible.
2. Since feedwater and condensate are operating, normal (non-1E) AC and DC power can be assumed to be available.
3. While makeup with clean sources of water is preferable, it is not required.
4. In implementing this strategy, the fire protection system may be used as a water source provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.
5. If a portable pumping capability is relied upon, the pump and necessary hoses will need to be stored on-site in an area at approximately 100 yards or more away from the target area in order to assure survivability and availability for the function.
6. Each site should consider that this makeup capability can be implemented prior to core uncovery following depletion of the hotwell, assuming that the hotwell is the only available water source to remove decay heat (i.e., the CST and suppression pool are not available).
7. On a site-specific basis, plants may justify a makeup rate to the hotwell of less than 300 gpm. The makeup rate must be at least 100 gpm greater than the rate necessary to remove decay heat.

3.4.5 Makeup to CST

Objective:

Provide a large volume makeup source to the condensate storage tank (CST) in order to supply ECCS long-term.

Performance Attributes:

1. Provide a means to makeup at least 300 gpm of water to the CST for a period of 12 hours. This could utilize the Phase 2 pump, or other existing sources. A makeup rate of less than 300 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement makeup source.

Response Elements:

- Provide a general description of how the CST refill will be accomplished.
- Describe the general locations of the primary equipment involved in providing makeup to the CST.
- Estimate flow rates expected to be delivered to the CST and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

It is possible to postulate damage to the plant that could affect normal CST makeup capability. This strategy is aimed at providing a source of makeup to the CST in order to provide an extended supply of water for RPV makeup.

The CST makeup capability should be documented in the submittal using the template provided in Table A.5-5.

Additional Considerations:

1. BWRs with Isolation Condensers (ICs) are not required to implement this strategy, if they do not have a RCIC system. Those sites will instead be managing IC heat exchanger level per Section 3.4.1.
2. For the purposes of this strategy, it should be assumed that areas immediately around the CST will be accessible.
3. Since manual operation of an RCIC pump could allow RPV makeup without AC or DC power, the implementation of this strategy should assume that

this is a LIPD condition and there is no on-site or off-site AC or DC power available.

4. While makeup with clean sources of water is preferable, it is not required.

5. In implementing this strategy, the fire protection system may be used as a water source provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities. It is recognized that fire system at many sites is the most flexible system that can be employed to mitigate many of the element associated with this effort. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.

6. If a portable pumping capability is relied upon, the pump and necessary hoses will need to be stored on-site in an area at approximately 100 yards or more away from the target area in order to assure survivability and availability for the function.

7. Each site should consider that this makeup capability can be implemented prior to core uncovery following depletion of the CST, assuming that the CST is the only water available to remove decay heat.

8. On a site-specific basis, plants may justify a makeup rate to the CST of less than 300 gpm based on the flow rate required to meet their site-specific MDRIR curve at the time of CST depletion. The makeup rate must be at least 100 gpm greater than the minimum MDRIR flowrate.

3.4.6 Maximize CRD

Objective:

Provide a means to makeup to RPV from a source independent of ECCS systems.

Performance Attributes:

1. All BWRs already include this strategy in EOPs. However, guidance to maximize CRD flow by starting the second pump, opening additional flow paths, and bypassing filters should be verified as these can significantly increase makeup flow rates.
2. For those sites that received "NRC June 20, 2006 Issuance of Order Requiring Compliance with Key Radiological Protection Mitigation Strategies (EA-06-137)", confirm implementation of this as part of their imminent threat procedures.

Response Elements:

- Provide a general description of how CRD flow will be maximized.
- Describe the locations of the primary equipment involved in maximizing CRD.
- Maximum estimated flow rates expected to be delivered to the RPV and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

This strategy is already part of the BWR Emergency Procedure Guidelines. However, the manner in which it is implemented may vary from plant to plant. In addition, the location of the CRD pumps and filters varies substantially.

The capability to maximize CRD should be documented in the submittal using the template provided in Table A.5-6.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that areas where the CRD pumps and valves are located will be accessible.
2. Maximizing CRD flow should involve starting the second pump, opening the flow control valves 100%, opening the second filter for each pump, and opening any bypass lines.
3. The maximum benefit from low flow systems like CRD comes when the action is taken promptly. So, procedural guidance for maximizing CRD flows should rapidly lead to these actions.

3.4.7 Procedure to Isolate RWCU

Objective:

Provide procedural direction to proactively isolate RWCU to minimize the risk of a LOCA outside containment.

Performance Attributes:

1. Confirm implementation of this as part of their imminent threat procedures.

Response Elements:

None required.

3.4.8 Manually Open Containment Vent Lines

Objective:

Provide a power-independent means to remove heat from containment by locally opening containment vent pathways.

Performance Attributes:

1. If manual operation of the valve is required, confirm availability of a means to open the valve and potentially to re-shut the valve, if conditions permit and termination of containment venting is warranted. Confirm availability of on-site air/N2 bottles either at the local pathway or in an area that is physically separate (approximately 100 yards or more from the target area).
2. Provide guidance on use of bottles to vent containment.

Response Elements:

- Provide a general description of how the containment vent lines will be opened/closed without normal air and power.
- Describe the general locations of the primary equipment involved in implementing the strategy.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

The goal of this strategy is to provide a means to relieve pressure from the containment in the event of a long-term loss of containment heat removal. The most likely cause of this is a LIPD event, but other scenarios can be envisioned (e.g., loss of essential service water with loss of control air or power). The most likely way that containment vent valves would be opened is by using a portable motive force (e.g., either air bottles or portable DC power supplies, depending on the type of valves involved).

The capability to manually open containment vent valves should be documented in the submittal using the template provided in Table A.5-8.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that Reactor Building and any other locations where vent valves are located will be accessible.
2. The implementation of this strategy should assume that this is a LIPD condition and there is no on-site or off-site AC or DC power available.
3. Any equipment (e.g., air bottles, portable power supplies, etc.) necessary to support opening the vent valves should either be stored in the vicinity of the location where the action must be taken, or in an area well removed from that location (e.g., a warehouse) so that access to other parts of the plant structures is not required.

3.4.9 Inject Water into the Drywell

Objective:

Provide cooling of the core debris and scrubbing of fission products, in the event core damage and vessel failure can not be prevented.

Performance Attributes:

1. Provide an AC-power-independent means to inject at least 300 gpm of water to the drywell for a period of 12 hours. The water injection can be directly to the drywell, or through lines connected to the RPV. This could utilize the Phase 2 portable pump or other existing sources. A makeup rate of less than 300 gpm may be justified on a site-specific basis.
2. Provide procedure/guidance to implement drywell injection capability.

Response Elements:

- Provide a general description of how the portable pump will be used to inject water into the drywell.
- Describe the general locations of the primary equipment involved in injecting water into the drywell, including any valves that must be manipulated.
- Estimate flow rates expected to be delivered to the drywell and identify the capacity of water supplies.

- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

This strategy is intended to be a backup to the use of the drywell spray or RPV injection systems.

The capability to inject water into the drywell using a portable pump should be documented in the submittal using the template provided in Table A.5-9.

Additional Considerations:

1. For the purposes of this strategy, it should be assumed that this is a LIPD condition and there is no on-site or off-site AC or DC power available.
2. Access to the Reactor Building can be assumed for this strategy. Given access to the Reactor Building, it can be assumed that the strategy for manually operating RCIC (Section 3.5.3) is also viable. This provides additional time for this strategy to be implemented
3. Since the objective is to put water into the drywell in order to flood the core debris after vessel failure, the injection can be routed through the drywell spray system, ECCS injection systems, or any other system that can route the water into the drywell. This strategy could utilize the Phase 2 pump, or other existing portable pumping sources. The connections could be accomplished by making use of vent and drain lines or other existing connection points on systems, or by providing a replacement valve bonnet that would have a flange/connector capable of accepting one or more hoses.
4. Containment pressure may be elevated (~design pressure), so the portable pump must be capable of providing the required flow at such pressures, including consideration of line losses which may be significant, depending on the routing. The site should have an engineering basis that provides reasonable assurance that the intended makeup rate and capacities can be provided. This basis should be auditable, but does not have to be a quality related calculation
5. The portable pumping capability and necessary hoses will need to be stored on-site in an area at approximately 100 yards or more away from the target area in order to assure survivability and availability of drywell injection.
6. Depending on the implementation, the approach taken to aligning the drywell makeup may also suffice for RPV makeup (Section 3.4.2)
7. On a site-specific basis, plants may justify a makeup rate to the drywell of less than 300 gpm. The makeup rate must be at least 100 gpm greater than the rate necessary to remove decay heat.

3.4.10 Portable Sprays

Objective:

Provide a means to reduce the magnitude of any fission product releases by spraying.

Performance Attributes:

1. Provide procedure/guidance on use of the portable spray capability provided for SFP mitigation in the event of a release from the Reactor Building/Containment.

Response Elements:

- Provide a general description of how the portable pump will be used to spray a radiological release including a description of portions of affected plant structures that cannot be sprayed due to physical layout or equipment limitations. This is intended to be a qualitative description of the portions of structures that are expected to be sprayable assuming there are no accessibility constraints.
- Describe the general locations of the primary equipment involved in use of portable sprays.
- Estimate spray flow rates expected to be delivered and identify the capacity of water supplies.
- Confirm that a procedure/guidance will be developed for implementing this strategy.

Submittal Guidance:

The purpose of these sprays is to mitigate any release of fission products from the Reactor Building/Containment.

The capability to spray using a portable pump should be documented in the submittal using the template provided in Table A.5-10.

Additional Considerations:

1. The purpose of this strategy is to spray a release coming from a damaged or failed containment. For the purposes of this strategy, it should be assumed that areas immediately around the containment will be accessible.
2. In implementing this strategy, consideration should be given to containing the runoff from the sprays. This may include providing a means to close off storm drains and/or providing materials to route runoff to a desired area.

Guidance on deployment of the sprays should consider the amount of spray water that can be contained.

3. In implementing this strategy, the fire protection system may be used as a water source provided the site procedures provide guidance on sharing/ balancing the use of these resources between fire fighting and makeup capabilities.. It is recognized that fire system at many sites is the most flexible system that can be employed to mitigate many of the element associated with this effort. If portions of the fire system must be relied on for implementation of this strategy the management of the system should be outlined in site procedures/guidelines. Guidance should include methods to isolate potentially damaged headers and if possible guidance for ring header sectionalization. Connection to the fire ring header should be approximately 100 yards or more from the target area. It can be assumed that the fire header itself is not damaged. However, the fire system management strategy should address isolation of fire headers inside structures that may be target areas. The pump used to charge the ring header should be located more than approximately 100 yards from the target area. If this separation does not exist, then some justification for pump survivability (e.g., intervening structures, nearly 100 yards away from key plant areas, contained in a reinforced concrete structure, etc.) should be provided in the submittal. Document the fire system management strategy in the submittal in Table A2-6.

4. The portable pumping capability, necessary hoses, and monitor nozzles will need to be stored on-site in an area approximately 100 yards or more away from the target area in order to assure survivability and availability for the spray function.

5. Utility PRA personnel can be consulted to identify the more likely release points. These should be considered when specifying the spray nozzles and pumping capability.

6. Releases that occur through a containment vent or through the site elevated release point are not expected to be sprayed.

7. In the event spray is to be used to mitigate a release, the implementing procedure/guideline should direct the spray flow rate be maximized to the extent the spray water can be contained. However, this does not imply that spray should/would be terminated in a real event simply because the capability to contain spray runoff is exceeded. In a real event, such decisions would be made by the ERO, based on the actual conditions.

3.5 DISPOSITION OF SITE-SPECIFIC ENHANCEMENT STRATEGIES

This step involves the review of the candidate enhancement strategies (CES) documented in the NRC's letter to each site on the closure of B.5.b Phases 1, 2, and 3. Those CES that were determined to be "High Confidence" and only involved implementation of Readily Available Measures (RAM) should be considered. In this context, Readily Available Measures are those that involve procedure/guidance enhancements, minimal procurement, and very minor modifications to safety-related and non safety-related systems. Due to the fact that these measures were identified without detailed assessment, each site should evaluate each identified CES that is considered a RAM to determine the true feasibility and benefit.

The assessment of CES that are RAM should include consideration of at least the following:

- Whether the RAM provides additional capability beyond that already available.
- Whether the RAM can be accomplished in the time available and plant conditions that may exist.
- Whether the RAM should be listed in site procedures or incorporated into plant procedures and training without unduly impacting the existing training regimen.

The collection of generic enhancement strategies and the high confidence plant-specific enhancement strategies that are found to be applicable and useful should be listed in site procedures or implemented by each site. These along with the collection of generic enhancement strategies will help to improve the sites flexibility to facilitate response efforts.

A listing of any other candidate enhancement strategies identified by the NRC that do not require modifications to the facility and are not adopted may be appended to plant implementing procedures/guidance for consideration by response personnel if conditions warrant. However, there is no intent to develop implementing procedures or to conduct training on these additional enhancements.

<u>Response Elements</u>:

For high confidence RAM strategies, procedures/guidance are to be developed for implementation.

For low confidence RAM strategies identified in the site assessments:

- Identify which additional enhancement strategies for each key safety function that were found to be viable.
- Determine if the strategy will be listed or implemented
- Identify where these strategies are identified for use by plant personnel.

The viability of each mitigation enhancement strategy should be evaluated with consideration of at least the following:

- Whether the strategy provides additional tangible capability beyond that already available.
- Whether the strategy can feasibly be accomplished with existing plant equipment in the time available and plant conditions that may exist. Thus, a strategy that requires a long time to establish or requires access to many areas of the plant may not be viable.

Each of these enhancements that are found to be viable should be identified in a plant procedure or guidance. It is sufficient to provide a list of the strategies retained. It is not necessary to specify the steps necessary for implementation; appropriate judgment should be used.

The enhancement strategies that will be listed or implemented into plant procedures/guidance should be documented in the submittal using the template provided in Table A.6-1.

<u>Additional Considerations</u>:

1. It may be useful to include plant PRA personnel in the evaluation of the identified strategies, as some readily available capabilities could be beneficial in reducing plant risks from causes other than security threats.

4.0 REFERENCES

1. NEI Letter from Marvin Fertel to Luis Reyes on Closure of Phase 2, January 24, 2006.
2. NEI Letter from Marvin Fertel to Luis Reyes on Closure of Phase 3, May 15, 2006.
3. NRC Letter from J.E. Dyer to Marvin Fertel on Phase 2 Closure, June 15, 2006.
4. NEI Letter from Marvin Fertel to William Kane on Closure of Phase 2, June 27, 2006.
5. NEI Letter from Marvin Fertel to William Kane on Closure of Phase 3, June 27, 2006.
6. NEI 05-07, "Industry Mitigation Strategy Study Guideline, Revision 1", December, 2005.
7. NRC Letter from J.E. Dyer to Marvin Fertel on B.5.b Closure, June 29, 2006.

APPENDIX A

Licensee Response Templates

A.1 Response Templates for Cover Letter

Appendix Not Included in this Revision

A.2 Response Templates for SFP Enhancement Strategies

Table A.2-1

PLANT: ___________

SFP Makeup – Internal Strategy	
GENERAL DESCRIPTION:	
Provide a general description of diverse Spent Fuel Pool (SFP) makeup capability, including the necessary personnel actions	
DIVERSITY OF MAKEUP:	
Describe how this capability meets the NEI guidance as "diverse"	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in implementing this strategy	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates and capacities	
Flow Rate to SFP:	
Water Source & Capacity:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation including guidance on decisions to makeup vs. spray.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.2-2

PLANT: ___________

SFP Makeup – External Strategy	
GENERAL DESCRIPTION:	
Provide a general description of Spent Fuel Pool (SFP) makeup capability	
EQUIPMENT LOCATIONS:	
Describe the locations of the primary equipment involved in implementing this strategy	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates and capacities	
Maximum Pump Flow Rate:	
Flow Rate to SFP:	
Water Source & Capacity:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation including guidance on decisions to makeup vs. spray.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.2-3

PLANT: ___________

SFP Spray – External Strategy	
GENERAL DESCRIPTION:	
Provide a general description of alternate Spent Fuel Pool (SFP) spray capability	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in implementing this strategy	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates and capacities	
Maximum Pump Flow Rate:	
Number of Monitor Nozzles:	
Capacity of Each Nozzle:	
Rate of Spray to SFP:	
Water Source & Capacity:	
BASIS FOR SPRAY ADEQUACY:	*Describe basis for providing 200 gpm per unit of spray to the SFP*
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation including guidance on decisions to makeup vs. spray and when to maximize spray.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.2-4

PLANT: ___________

Viable Site-specific SFP Mitigation Strategies	
Strategy	**List/Implement**
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.2-5

PLANT: ___________

SFP Leakage Control Strategies	
GENERAL DESCRIPTION:	
• *Provide a list of the types of leakage control capabilities currently available on site and their general location* • • • •	
PROCEDURE/GUIDANCE:	
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.2-6

PLANT: __________

Fire System Management Strategies	
GENERAL DESCRIPTION:	
• *Generally describe the capabilities available to isolate the site fire header from major structures in the event damage to the structure compromises the integrity of the fire protections system. For example, describe how the fire header feeding the structure containing the SFP can be isolated.* *If the site fire header is intended to be used for reactor mitigation strategies, the capability to isolate other structures may also need to be described (e.g., Auxiliary Buildings, Reactor Buildings, Control Buildings, etc.).*	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

A.3 Response Templates for Command and Control Enhancement Strategies

Table A.3-1

PLANT: ___________

Command and Control Enhancements

ONSITE & OFFSITE COMMUNICATIONS:

- *Provide a general description of the diverse methods available to communicate with off-site personnel that could be effective for the conditions assumed*
- *Provide a general description of the approach for mustering the available plant resources in the event the control room/staff are substantially affected*
- *Provide a general description of Operations/Security pre-plans for re-establishment of communications immediately following a large fire or explosion*
- *Provide a general description of how operations and security personnel will coordinate activities immediately following a large fire or explosion*

NOTIFICATIONS OF THE UTILITY ERO:

- *Provide a general description of the command and control structure that will be established prior to arrival offsite resources, in the event the control room/staff are substantially affected*
- *Provide a general description of the approach(es) for making the appropriate off-site notifications of the utility ERO and ERO callout in the event the control room/staff are substantially affected*
- *Confirm that a procedure/guidance and training exists or will be developed for ERO and offsite notifications of the utility ERO for the postulated conditions.*

INITIAL OPERATIONAL RESPONSE ACTIONS:

- *Provide a general description of the entry conditions for the procedure/guidance on initial operation response actions*
- *Provide a general description of the initial operational response actions addressed*
- *Confirm that a procedure/guidance and training exists or will be developed for the initial operational response under the postulated condition.*

EQUIPMENT LOCATIONS:

Describe the general locations of the primary equipment involved the initial operational response actions

Equipment	**Location**

INITIAL DAMAGE ASSESSMENT:

- *Provide a general description of the damage assessment to be provided to the ERO*
- *Confirm that a procedure/guidance and training exists or will be developed for initial damage assessments*

A.4 Response Templates for PWR Reactor and Containment Enhancement Strategies

Table A.4-1

PLANT: ___________

PWR Enhancement Strategy #1 **RWST Makeup**	
GENERAL DESCRIPTION:	
Provide a general description of how makeup to the RWST will be accomplished	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in providing makeup to the RWST	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates and capacities	
Flow Rate to RWST:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.4-2

PLANT: ___________

<table>
<tr><td colspan="3"><u>PWR Enhancement Strategy #2</u>
Manually Depressurize SGs to Reduce RCS Inventory Loss</td></tr>
<tr><td colspan="3">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="3">Provide a general description of how the
manual depressurization of the SGs will be accomplished

If relying on existing procedures, confirm applicability to postulated conditions</td></tr>
<tr><td colspan="3">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="3">Describe the general locations of the primary equipment
involved in manual depressurization</td></tr>
<tr><td colspan="2"><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td colspan="2">Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="3">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.4-3

PLANT: ___________

<table>
<tr><td colspan="2"><u>PWR Enhancement Strategy #3</u>
Manual Operation of Turbine-driven (or Diesel-driven) AFW Pump</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="2">Provide a general description of how manual operation of the AFW pump will be accomplished</td></tr>
<tr><td colspan="2">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="2">Describe the general locations of the primary equipment involved in manual operation of AFW</td></tr>
<tr><td><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="2">Estimate flow rates expected to be delivered to the SGs and identify the capacity of water supplies</td></tr>
<tr><td>Flow Rate to SGs:</td><td></td></tr>
<tr><td>Capacity of Water Source:</td><td></td></tr>
<tr><td>INSTRUMENTATION/ OPERATOR AIDS:</td><td>Describe approach to be taken to managing SG level including instrumentation and/or operator aids to be employed</td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td>Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="2">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.4-4

PLANT: ___________

<table>
<tr><td colspan="2"><u>PWR Enhancement Strategy #4</u>

Manually Depressurize SGs and Use Portable Pump</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="2">Provide a general description of how the portable pump will be used.

If different than strategy #2, describe how manual depressurization of the SGs will be accomplished</td></tr>
<tr><td colspan="2">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="2">Describe the general locations of the primary equipment involved in use of the portable pump and depressurizing the SGs</td></tr>
<tr><td><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="2">Estimate flow rates expected to be delivered to the SGs and identify the capacity of water supplies</td></tr>
<tr><td>Flow Rate to SG(s):</td><td></td></tr>
<tr><td>Capacity of Water Source:</td><td></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td>Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="2">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.4-5

PLANT: ___________

<u>PWR Enhancement Strategy #5</u> **Makeup to CST**	
GENERAL DESCRIPTION:	
Provide a general description of how makeup to the CST will be accomplished	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in makeup to the CST	
<u>Equipment</u>	**<u>Location</u>**
CAPACITIES & FLOWRATES:	
Estimate flow rates expected to be delivered to the CST and identify the capacity of water supplies	
Flow Rate to CST:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.4-6

PLANT: ___________

<table>
<tr><td colspan="3"><u>PWR Enhancement Strategy #6</u>

Containment Flooding with Portable Pump</td></tr>
<tr><td colspan="3">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="3">Provide a general description of how makeup containment flooding will be accomplished with the portable pump, including the flow pathway into containment.</td></tr>
<tr><td colspan="3">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="3">Describe the general locations of the primary equipment involved in flooding containment</td></tr>
<tr><td colspan="2"><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="3">Estimate flow rates expected to be delivered to the containment and identify the capacity of water supplies</td></tr>
<tr><td>Flow Rate to Containment:</td><td colspan="2"></td></tr>
<tr><td>Capacity of Water Source:</td><td colspan="2"></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td colspan="2">Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="3">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.4-7

PLANT: ___________

<u>PWR Enhancement Strategy #7</u> **Portable Sprays**	
GENERAL DESCRIPTION:	
Provide a general description of how portable sprays will be used including a description of portions of affected plant structures that cannot be sprayed due to physical layout or equipment limitations	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in the use of portable sprays	
<u>Equipment</u>	**<u>Location</u>**
CAPACITIES & FLOWRATES:	
Estimate spray flow rates and identify the capacity of water supplies	
Estimated Spray Flow Rate:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

A.5 Response Templates for BWR Reactor and Containment Enhancement Strategies

Table A.5-1

PLANT: ________

BWR Enhancement Strategy #1 Manual Operation of RCIC or Isolation Condenser	
GENERAL DESCRIPTION:	
Provide a general description of how manual operation of the RCIC pump or Isolation Condenser (IC) will be accomplished	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in manual operation of RCIC/IC	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates expected to be delivered to the RPV and identify the capacity of water supplies	
Estimated Flow Rate to RPV (RCIC):	
Estimated Makeup Rate to IC (IC):	
Capacity of Water Source:	
INSTRUMENTATION/ OPERATOR AIDS:	*Describe approach to be taken to managing RPV/IC level including instrumentation and/or operator aids to be employed*
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.5-2

PLANT: ___________

<u>BWR Enhancement Strategy #2</u> **DC Power Supplies to Allow Depressurization of RPV & Injection With Portable Pump**	
GENERAL DESCRIPTION:	
Provide a general description of how DC Power supplies will be used to allow depressurization of RPV & injection with portable pump	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in depressurizing and using the portable pump	
<u>Equipment</u>	**<u>Location</u>**
CAPACITIES & FLOWRATES:	
Estimate flow rates expected to be delivered to the RPV and identify the capacity of water supplies	
Flow Rate to RPV:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.5-3

PLANT: ___________

<u>BWR Enhancement Strategy #3</u> **Utilize Feedwater & Condensate**
No response required for this strategy

Table A.5-4

PLANT: __________

<table>
<tr><td colspan="2"><u>BWR Enhancement Strategy #4</u>
Makeup to Hotwell</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="2">Provide a general description of how makeup
to the hotwell will be accomplished</td></tr>
<tr><td colspan="2">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="2">Describe the general locations of the primary equipment
involved in makeup to the hotwell</td></tr>
<tr><td><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="2">Estimate flow rates expected to be delivered to the hotwell
and identify the capacity of water supplies</td></tr>
<tr><td>Flow Rate to Hotwell:</td><td></td></tr>
<tr><td>Capacity of Water Source:</td><td></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td>Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="2">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.5-5

PLANT: ___________

BWR Enhancement Strategy #5 **Makeup to CST**	
GENERAL DESCRIPTION:	
Provide a general description of how makeup to the CST will be accomplished	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in makeup to the CST	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate flow rates expected to be delivered to the CST and identify the capacity of water supplies	
Flow Rate to CST:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.5-6

PLANT: ___________

<table>
<tr><td colspan="3"><u>BWR Enhancement Strategy #6</u>

Maximize CRD</td></tr>
<tr><td colspan="3">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="3">Provide a general description of how CRD flow to the RPV will be maximized</td></tr>
<tr><td colspan="3">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="3">Describe the general locations of the primary equipment
involved in maximizing CRD</td></tr>
<tr><td colspan="2"><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="2"></td><td></td></tr>
<tr><td colspan="3">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="3">Estimate flow rates expected to be delivered to the RPV
and identify the capacity of water supplies</td></tr>
<tr><td>Maximum Estimated Flow Rate to RPV:</td><td colspan="2"></td></tr>
<tr><td>Capacity of Water Source:</td><td colspan="2"></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td colspan="2">Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="3">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.5-7

PLANT: ___________

BWR Enhancement Strategy #7 **Procedure to Isolate RWCU**	
GENERAL DESCRIPTION:	
Confirm that procedures exist to isolate RWCU in the event of an imminent threat	
PROCEDURE/GUIDANCE:	*Identify which procedure/guidance is used.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

Table A.5-8

PLANT: ___________

<table>
<tr><td colspan="2"><u>BWR Enhancement Strategy #8</u>

Manually Open Containment Vent Lines</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="2">Provide a general description of how containment vent lines will be manually opened/closed.</td></tr>
<tr><td colspan="2">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="2">Describe the general locations of the primary equipment involved in manually venting containment</td></tr>
<tr><td><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td>Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="2">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.5-9

PLANT: ___________

<table>
<tr><td colspan="2"><u>BWR Enhancement Strategy #9</u>

Inject Water Into the Drywell</td></tr>
<tr><td colspan="2">GENERAL DESCRIPTION:</td></tr>
<tr><td colspan="2">Provide a general description of how
the portable pump will be used to inject water into the drywell</td></tr>
<tr><td colspan="2">EQUIPMENT LOCATIONS:</td></tr>
<tr><td colspan="2">Describe the general locations of the primary equipment
involved in injecting to the drywell</td></tr>
<tr><td><u>Equipment</u></td><td><u>Location</u></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">CAPACITIES & FLOWRATES:</td></tr>
<tr><td colspan="2">Estimate flow rates expected to be delivered to the drywell
and identify the capacity of water supplies</td></tr>
<tr><td>Flow Rate to Drywell:</td><td></td></tr>
<tr><td>Capacity of Water Source:</td><td></td></tr>
<tr><td>PROCEDURE/GUIDANCE:</td><td>Confirm that procedure/guidance exists or will be developed to support implementation.</td></tr>
<tr><td colspan="2">NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):</td></tr>
</table>

Table A.5-10

PLANT: ___________

BWR Enhancement Strategy #10 **Portable Sprays**	
GENERAL DESCRIPTION:	
Provide a general description of how portable sprays will be used including a description of portions of affected plant structures that cannot be sprayed due to physical layout or equipment limitations	
EQUIPMENT LOCATIONS:	
Describe the general locations of the primary equipment involved in the use of portable sprays	
Equipment	**Location**
CAPACITIES & FLOWRATES:	
Estimate spray flow rates and identify the capacity of water supplies	
Estimated Spray Flow Rate:	
Capacity of Water Source:	
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

A.6 Response Templates for Disposition of Site-specific Strategies

Table A.6-1

PLANT: ___________

Viable Site-specific Reactor/Containment Mitigation Strategies	
Strategy	**List/Implement**
PROCEDURE/GUIDANCE:	*Confirm that procedure/guidance exists or will be developed to support implementation.*
NOTES (INCLUDE DEVIATIONS/JUSTIFICATIONS):	

APPENDIX B

Example Equipment Specifications

<u>Disclaimer</u>

The example equipment specifications included in this Appendix represent commercially available equipment that is generally expected to meet or exceed the requirements at most sites. Commercial grade water pumping and fire fighting equipment is widely available. Inclusion of specific products by individual companies is not meant to be a specific endorsement of individual products or companies, but rather is provided to serve as examples of products and services that individual utilities may find useful.

Table B-1

POTENTIAL STRATEGIES UTILIZING PORTABLE PUMP

Strategy	Minimum Flow Requirements	Other Factors
SPENT FUEL POOL MITIGATION		
SFP Makeup	500 gpm to Spent Fuel Pool	• Elevation of SFP • Line losses
SFP Spray	200 gpm/unit to Spent Fuel Pool	• Elevation of SFP • Line losses
PWR REACTOR MITIGATION		
RWST Makeup	300 gpm to RWST or Rate Sufficient to Exceed Decay Heat	• Line losses
Steam Generator Makeup	200 gpm to SG or Rate Sufficient to Remove Decay Heat	• SG Pressure • Line losses
CST Makeup	200 gpm to SG or Rate Sufficient to Remove Decay Heat	• Line losses
Containment Flooding	300 gpm to Containment or Rate Sufficient to Exceed Decay Heat	• Elevated containment pressure (design pressure) • Line losses
Release Mitigation (Spray)	≥200 gpm	• Line losses • Elevation of likely release points
BWR REACTOR MITIGATION		
Hotwell Makeup	≥300 gpm or Rate Sufficient to Exceed Decay Heat	• Line losses
CST Makeup	≥300 gpm or Rate Sufficient to Exceed Decay Heat	• Line losses
RPV Injection with SRVs open via temporary Power Supply	≥300 gpm to RPV or Rate Sufficient to Exceed Decay Heat	• Line losses • Number of SRVs and corresponding Reactor Pressure
Drywell Injection	300 gpm to Containment or Rate Sufficient to Exceed Decay Heat	• Elevated containment pressure (design pressure) • Line losses
Release Mitigation (Spray)	≥200 gpm	• Line losses • Elevation of likely release points

B.1 Kidde Fire Example Pump Package

Example Kidde-Fire Fighting Products

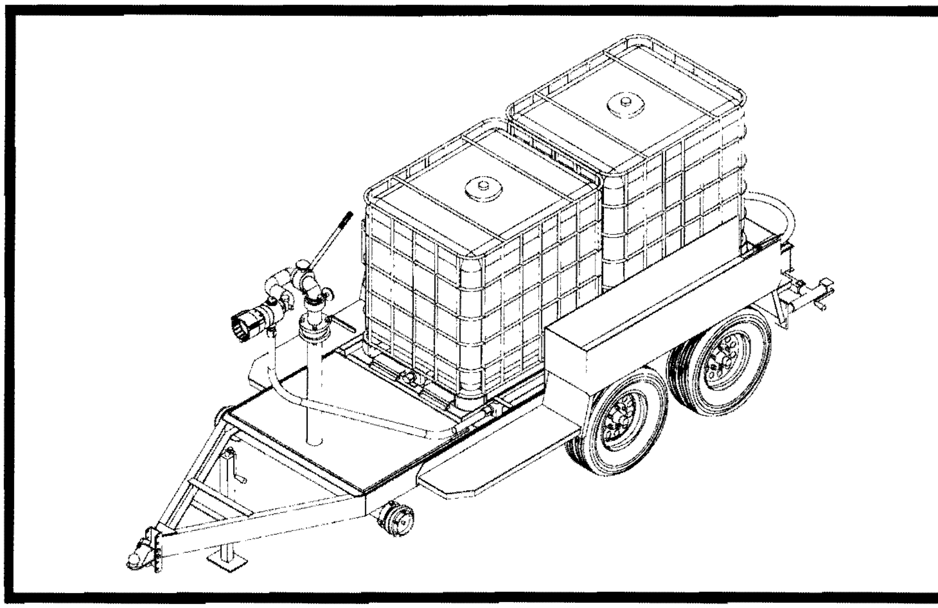
The following information represents products currently available from Kidde-Fire Fighting. Kidde-Fire Fighting has worked with a nuclear utility to develop a backup cooling capability and has worked with the Department of Homeland Security to provide regional emergency response capabilities. The products developed by Kidde-Fire Fighting generally exceed the base requirements identified for B5b Phase 2 & 3 resolution. NEI-Kidde-Fire Fighting has regional offices and field representatives who can provide consultation to ensure site specific attributes and needs are considered. They can assist with assembling a base system to meet minimum requirements or provide an enhanced system. More product information is available at www.Kidde-Fire.com. The Kidde-Fire initial point of contact is Brayn Rambo.

Name	Bryan Rambo
Title	Business Dev. Manager
Phone	(610) 594-4092
Email	bryan.rambo@kidde-fire.com

NATIONAL FOAM

DATA SHEET #NME080

DUAL FOAM TOTE TRAILER



Description

The Dual Foam Tote Trailer provides a large storage capacity for foam concentrate along with the high performance delivery of the patented technology found in the Gladiator® nozzle in one complete fire fighting package. The trailer is available with dual tote tanks in either the 275 gallon or 330 gallon sizes. This portable fire fighting package provides plenty of flexibility and fire extinguishing power to your arsenal, and is available with a variety of options which allow you to customize your trailer to suit your needs. National Foam Tote Trailers are totally self contained, needing only a source of water to be put in service at a moments notice.

Features

- Direct nozzle concentrate pick-up connectionsf o r both front and rear tote tanks.
- Stainless steel slide rails on trailer deck to allow easier movement of full tote tanks.
- Quick release tie-down bars for both tote tanks.
- Bright aluminum tread plate hose bins and fenders on both sides of trailer.
- Non-slip aluminum deck surface at monitor base.
- 3" in-line butterfly valve in monitor riser.
- Trailer is fully DOT compliant and road-ready.

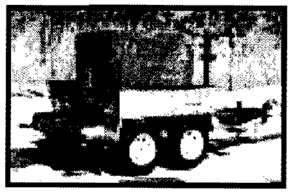
Applications

The Tote Trailer is an ideal alternative to the handling of drums or pails, or relying on a foam tanker during a major flammable liquid incident. With the pre-piped, trailer mounted monitor, it can be placed into action immediately upon arrival on the scene, and does not require special positioning since the monitor piping allows for the water supply to be connected to either side of the trailer.

Specifications

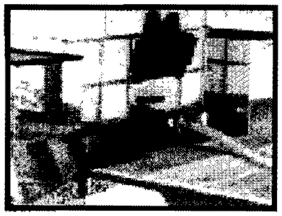
- 10,000 GVWR Trailer with electric brakes on both axles. (Surge hydraulic brakes optional)
- 7,000 pound capacity drop-foot front jack and dual 5,000 pound capacity swing-down rear jacks for stabilization.
- Pre-piped MMAM 3 x 2-1/2 aluminum monitor with any 2-1/2" Gladiator Nozzle, 500 to 1000 GPM.
- Water inlet connections either side.
- 3-inch Butterfly Valve with long neck gear operator.
- Quick-action tank connectors for front and rear tote tanks, with remote valve at monitor platform for rear tank.
- Aluminum hose bins located above fenders are suitable for storage of 2-1/2", 3", 4" or 5" hose.

Stainless steel rub rails and quick action clamp

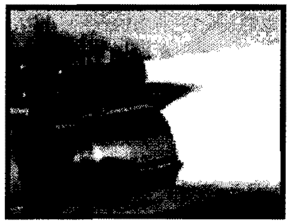


Constructed of bright aluminum tread plate

500, 750 or 1000 gpm Gladiator nozzle for Class A or B foam



Direct Tank Hook-Up to Nozzle

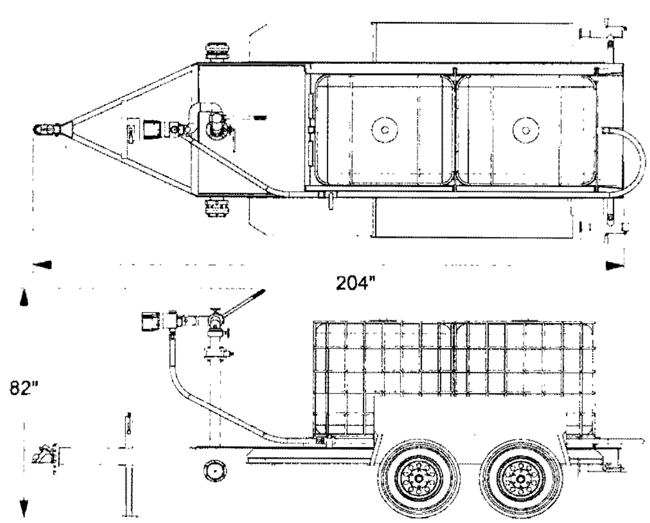


Optional Dual Agent (Foam-Dry Chemical Nozzle)

Optional Vinyl Cover

Options

- Dual Tote Trailer 275 gallon or 330 gallon.
- Red vinyl tote cover.
- 2-1/2" Gladiator Nozzle 500 gpm fixed, metering, or tri-flow.
- 2-1/2" Gladiator Nozzle 750 gpm fixed 1% or 3%.
- 2-1/2" Gladiator Nozzle 1000 gpm fixed 1% or 3%.
- Dry-Chemical Gladiator Nozzle attachment with flows up to 30 pounds per second available.
- Hose bin mounted line proportioners available.
- Monitor inlet piping available in dual Storz connections.



Notes

- Shipment approximately 10 - 12 weeks after receipt of order at National Foam.
- Foam concentrate and tote not included as part of trailer. Foam concentrate and tote must be ordered separately.
- Delivery cost not included.

Ordering Information

Dual Tote Trailer - Base 10,000 GVWR trailer with electric brakes, swing-down jacks, inlet adapters (as noted below with description), pre-piped MMAM 3 x 2-1/2 monitor with any 2-1/2 Gladiator Nozzle 500 to 1000 GPM, 3 inch butterfly valve, quick-connect tote connections, two aluminum hose bins, and pressure/vacuum vent.

Note: Trailers noted below do not include foam tote or foam concentrate.

5100-2000-1 .... Dual Tote Trailer - (2) Siamese 4" FNPT x 2.5" FSWNH
5100-2000-2 .... Dual Tote Trailer - (2) Adapter 4" FNPT x 4" MNH
5100-2000-3 .... Dual Tote Trailer - Adapter 4" FIPT Inlet x 4" Storz
5100-2000-4 .... Dual Tote Trailer - Adapter 4" FNPSH Inlet x 5" Storz

Trailer Options:

1292-2000-2 .... Cover, Red Vinyl, for 275 or 330 gallon tote
1292-2002-1 .... Cover, Red Vinyl, for (1) Hose Bin on Dual Tote Trailer

This information is only a general guideline, and each installation may require modifications to meet the applications or requirements of that situation. The company reserves the right to change any portion of this information without notice. Terms and conditions of sale apply and are available on request.

12/01 (Rev C) Printed in U.S.A. (NME080.PMD)

NATIONAL FOAM, INC.
P.O. Box 695 • Exton, PA 19341-0695 • (610) 363-1400 • Fax: (610) 524-9073
www.Kidde-Fire.com

NATIONAL FOAM

DATA SHEET
#NME010

TERMINATOR II™
HIGH CAPACITY FOAM/WATER MONITOR

Description

The Terminator II™ takes high capacity portable monitors to a new level of performance. This latest generation offers significant enhancements in operation and foam performance. Portability and quick set up make the Terminator II the best fire fighting monitor package available anywhere.

The totally new Gladiator® self inducting adjustable aspiration nozzle technology enables the most effective and flexible fire attack. The unique foam producing characteristics make it the first nozzle of its kind suitable for use with protein, fluoroprotein, AFFF, and AR-AFFF foam concentrates. Before the Gladiator nozzle, firefighters had to settle for minimal foam performance from high capacity monitors. Now you can have it all in a single package; excellent nozzle range, ease of operation, and superior foam performance! See Data Sheet #NDD180 for Gladiator details.

The Terminator II™ is designed for use with pre-mixed foam solution, however, the unit is configured for remote foam concentrate pick-up using jet pump(s). See Data Sheet #NME020 for Jet Pump details.

Features

- Excellent Stream Range and Quality.
- Lightweight and Easy to Set Up.
- Unique Outrigger Design Compensates For Up to 10" (254mm) of Uneven Ground.
- Self Educting Proportioning - Director Secondary Eductor Method.
- SelectAir™ Adjustable Aspiration For Optimum Foam Performance.
- Maximum Stream Performance With Minimum Foam Fallout.
- Compatible With All Major Types Of Foam Concentrate.

Operation

The Terminator II is designed for quick set up and smooth, easy operation. The weight balanced design of the trailer permits movement and positioning by two people, even in congested areas. This means if redeployment is required, reconnecting to a towing vehicle is not necessary.

The innovative stabilizer system provides for quick setup since there are only two leveling jacks to deploy. The extendable rear outriggers have a unique self leveling feature that automatically adjusts for up to 10" (254 mm) of uneven ground between them. Simply slide out the two outriggers, and level the unit by adjusting the front stabilizer jacks.

The Terminator II also incorporates an ergonomic operator control station which features a combination pressure gauge and flow meter. This allows constant monitoring of nozzle flow and pressure to insure optimum performance.

Foam Proportioning

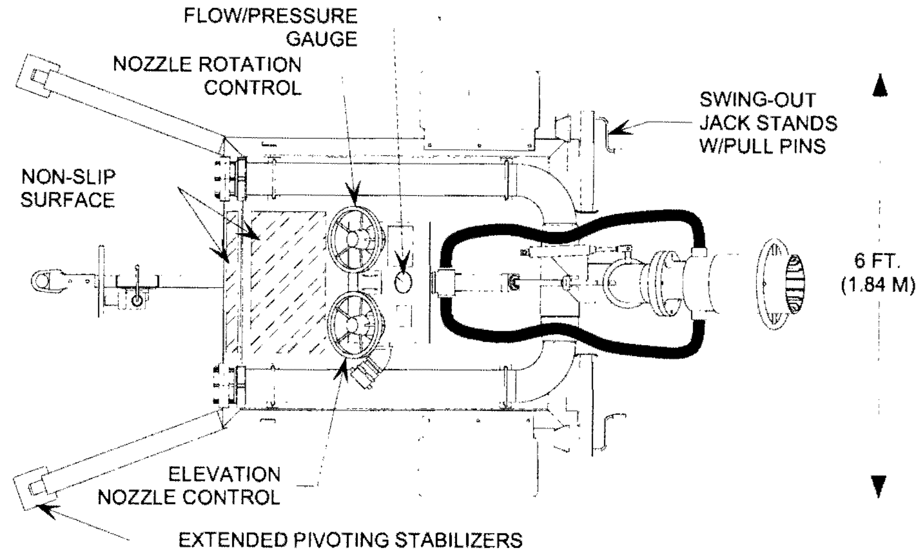
The Terminator II uses water powered Jet Pump proportioning eliminating the need for outside power sources resulting in easier, more reliable operations. The Jet Pump operates with all types of foam concentrates for ultimate flexibility. Various pickup tube configurations allow you to draw foam from a variety of containers for uninterrupted operation.

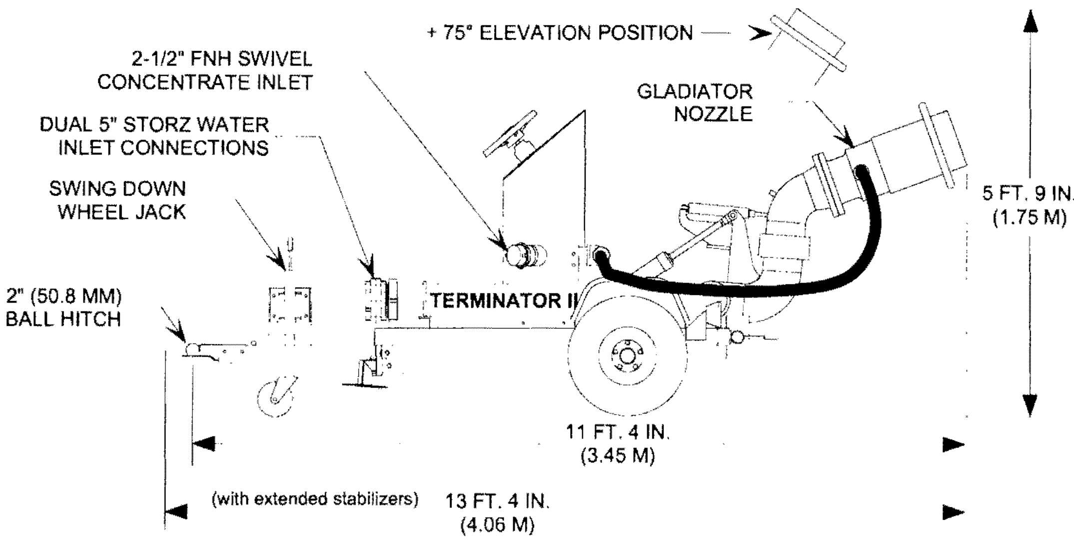
Foam Performance

Every Terminator II comes equipped with the new Gladiator Foam/Water Nozzle. The Gladiator represents the latest advancement in foam firefighting nozzle technology. The Gladiator's totally new design makes it the first self educting nozzle with the ability to deliver optimum performance with water or foam.

Gladiator's innovative internal design, and stream straightening vanes eliminate swirling to optimize stream range with minimal foam loss due to fallout.

Gladiator has unique adjustable foam aspiration capability which allows the operator to switch between the initial penetrating punch of a non-aspirating nozzle, to the superior foam blanket performance of an aspirating nozzle. Switch over from non-aspirating to aspirating can be done by simply adjusting the control handle while the nozzle is flowing.





All dimensions in inches (mm) unless noted

Operating Parameters

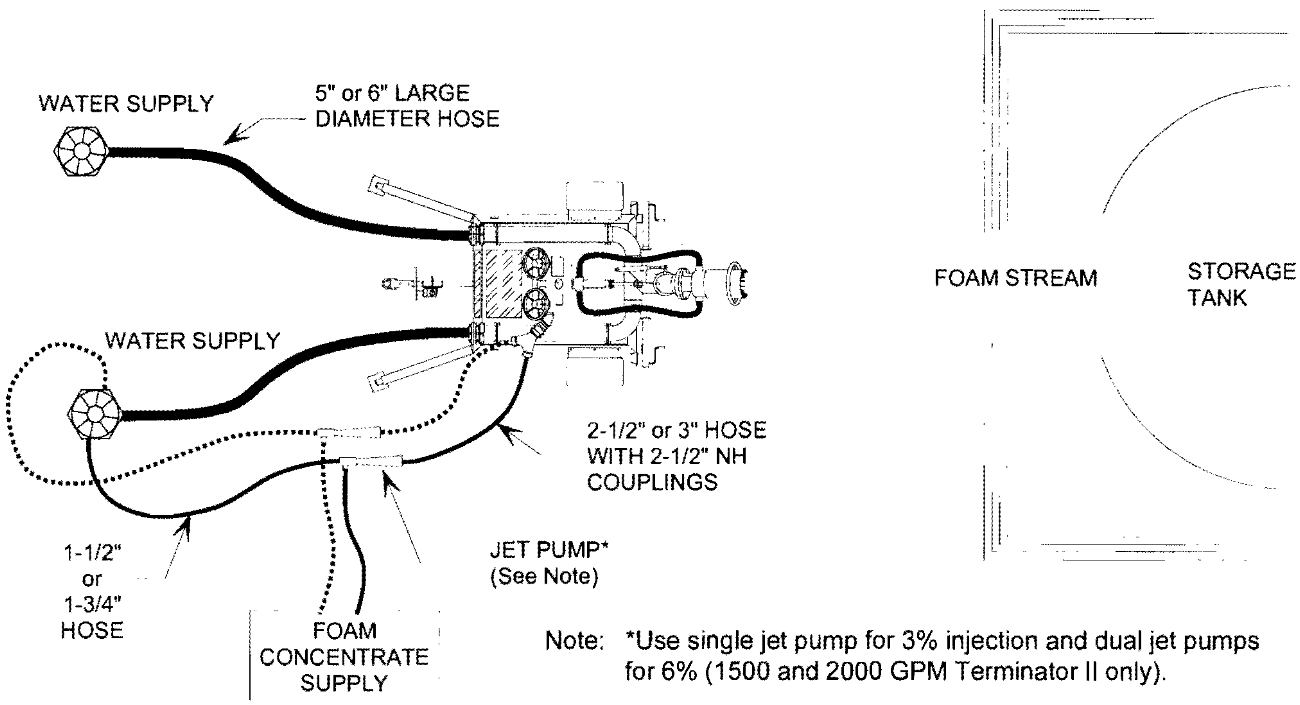
Minimum Inlet Pressure .... 75 PSI (5.1 Bar)
Nominal Inlet Pressure .... 100 PSI (6.9 Bar)
Maximum Inlet Pressure .... 125 PSI (8.6 Bar)
Available Nozzle Flow Rates .... 1500 GPM (5678 lpm)
@ 100 PSI (6.9 Bar) 2000 GPM (7570 lpm)
3000 GPM (11,355 lpm)
Monitor Elevation .... +20° to +75° above 0° horizontal
Monitor Rotation .... 30° each side of center position
Water Inlet Connections .... Two 5" (127 mm) Storz
Foam Inlet .... 2 1/2" Female Swivel NH (NST) Connections
Weight: Total Monitor and Trailer .... 1420 lbs. (644 kg.)

Performance Data

	Nozzle Pressure PSI (Bar)	Flow GPM (LPM)
Terminator II - 1500	75 (5.2)	1,299 (4,917)
	100 (6.9)	1,500 (5,678)
	125 (8.6)	1,677 (6,347)
Terminator II - 2000	75 (5.2)	1,732 (6,556)
	100 (6.9)	2,000 (7,570)
	125 (8.6)	2,236 (8,464)
Terminator II - 3000	75 (5.2)	2,598 (9,834)
	100 (6.9)	3,000 (11,355)
	125 (8.6)	3,354 (12,695)

This sheet contains only a general description of the Terminator II and its capabilities. Actual performance will depend upon existing conditions at the time of use and operator training. Under no circumstances shall the product be used except by qualified, trained personnel and not until the instructions, labels or literature accompanying it have been carefully read and understood and the precautions contained therein followed. Only the operating manual contains complete information concerning the products.

Typical Setup Arrangement for Terminator II with Jet Pump Proportioner



Note: *Use single jet pump for 3% injection and dual jet pumps for 6% (1500 and 2000 GPM Terminator II only).

Estimating Fire Flows

Determining required fire flows is an important consideration in the overall incident preplan. Foam delivery from monitors produces a rough application where the foam plunges into the fuel and resurfaces to form a blanket on top of the fuel. This plunging type application causes fuel contamination of the foam blanket which is detrimental to foam performance.

For this reason NFPA-11 Standard For Low Expansion Foam recommends higher application rates for protection of storage tanks with monitors. Monitors are classified by Underwriters Laboratories (U.L.) as Type III discharge devices, as opposed to gentle foam application devices which minimize plunging such as foam chambers. Foam Chambers are classified as Type II discharge devices.

According to NFPA-11, the minimum recommended application rate for standard hydrocarbon fuels is 0.16 gpm/ft^2 (6.5 l/min/m^2) when applied by monitors. As a comparison, foam chambers or other Type II discharge devices require a minimum application rate of 0.10 gpm/ft^2 (4.1 l/min/m^2) for the same hydrocarbon fuels. The 60% increase in application rate for Type III discharge devices is designed to compensate for the destructive effects of plunging the foam into the fuel. When polar solvents or oxygenated fuels are involved the application rates should be adjusted accordingly. Consult the foam manufacturer for specific recommendations.

Once the minimum application rate is established, the theoretical flow rate can be calculated by multiplying the surface area of the tank by the application rate. An important point to remember about NFPA-11 application rates is the assumption that all the foam reaches the fuel surface. In the case of foam chambers this is a logical assumption. However in the case of monitors, a safety factor needs to be added to account for the foam that does not reach the fire surface due to wind, nozzle range, nozzle fallout, etc. A good estimate would be 70% to 80% of the total flow actually reaches the fuel surface.

Design Example

Storage Tank, 150 ft. (45.7m) Diameter:

Surface Area $= \pi \times \text{diameter}^2 \div 4$
$= 3.14 \times 150^2 : 4$
$= 17{,}663$ ft^2

Flow Rate $= 17{,}663$ ft^2 $\times$ 0.16 gpm/ft^2
$= 2{,}826$ gpm

If the assumption is made that only 80% of the flow reaches the fuel surface, then the flow rate should be increased by 20% (100% - 80%).

Flow Rate including safety factor:

2,826 gpm X 1.20 = 3,391 gpm

Ordering Information

TERMINATOR II WITH GLADIATOR NOZZLE

Part No.	Description
1252-0410-8	Terminator II with 1500 GPM (5678 lpm) @ 100 PSI (6.9 Bar) Gladiator Nozzle - 3% Proportioning
1252-0410-9	Terminator II with 1500 GPM (5678 lpm) @ 100 PSI (6.9 Bar) Gladiator Nozzle - 6% Proportioning
1252-0411-0	Terminator II with 2000 GPM (7570 lpm) @ 100 PSI (6.9 Bar) Gladiator Nozzle - 3% Proportioning
1252-0411-1	Terminator II with 2000 GPM (7570 lpm) @ 100 PSI (6.9 Bar) Gladiator Nozzle - 6% Proportioning
1252-0411-2	Terminator II with 3000 GPM (11351 lpm) @ 100 PSI (6.9 Bar) Gladiator Nozzle - 3% Proportioning

COMPATIBLE JET PUMP KITS FOR TERMINATOR II - DOES NOT INCLUDE PICKUP HOSE KIT

Terminator II	Compatible Jet Pump Kit		
Description	Model No.	Part No.	Description
1500 GPM - 3%	JP-1500 3%	1252-0412-0	Single jet pump 1 1/2" NH femal swivel inlet x 2 1/2" NH male outlet
1500 GPM - 6%	JP-1500 6%	1252-0412-1	Dual jet pump with 2 1/2" siamese fitting for foam inlet at Terminator
2000 GPM - 3%	JP-2000 3%	1252-0412-2	Single jet pump 1 1/2" NH female swivel inlet x 2 1/2" NH male outlet
2000 GPM - 6%	JP-2000 6%	1252-0412-3	Dual jet pump with 2 1/2" siamese fitting for foam inlet at Terminator
3000 GPM - 3%	JP-3000 3%	1252-0412-4	Single high capacity jet pump 1 1/2" NH female swivel inlet x 2 1/2" NH male outlet

PICKUP TUBE KITS

Pickup tube kits consist of 2" pickup dip tube(s) with shut off valve, clear plastic reinforced flexible pickup hose(s) 12 feet long with 2" NPSH (straight pipe thread) couplings. Dual and quad pickup kits also contain certain pipe fittings for interconnecting the pickup hoses. All pickup tube kits fit onto 2" NPSH male (straight pipe thread) connection at the jet pump foam inlet and dip tube. Therefore any jet pump can be used with single, dual or quad pickup tube kits listed below:

Part No.	Description
1252-0413-0	Single pickup tube kit consisting of 1 dip tube with shut off valve and 1 pickup hose. This kit allows foam to be taken from one drum or tote tank.
1252-0413-1	Dual pickup tube kit consisting of 2 dip tubes with shut off valves, 2 pickup hoses, and interconnecting fittings. This kit allows foam to be taken from two drums or two tote tanks simultaneously.
1252-0413-2	Quad pickup tube kit consisting of 4 dip tubes with shut off valves, 4 pickup hoses, and interconnecting fittings. This kit allows foam to be taken from four drums or four tote tanks simultaneously.

It is recommended that the JP-1500-6%, JP-2000-6%, and JP-3000-6% jet pumps be used with either dual or quad pickup tube kits, due to relatively high foam concentrate flow rates.

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NATIONAL FOAM

DATA SHEET
#NME040

THE DOMINATOR
5000 GPM
PORTABLE PUMP PACKAGE

Description

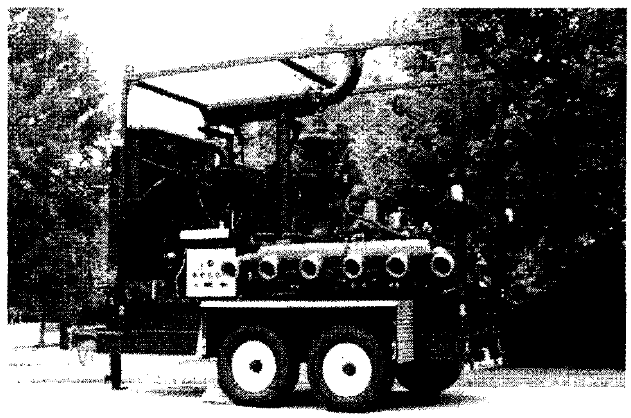
The National Foam 5000 GPM Skid Mounted Diesel Pump with a nominal performance rating of 5000 GPM at 150 PSI when operating with a six-foot suction lift. The pump and engine are mounted on a box frame base, which serves as a 300-gallon fuel tank. The pump skid has a stainless steel suction manifold with (6) 6" NH connections, and stainless steel discharge manifold with (1) 2½" NH valved discharge and (5) 5" valved storz connections. The unit is equipped with an operators panel containing engine controls and manifold pressure gauges. The pump electrical system is 24VDC and the unit is furnished with two (2) heavy-duty batteries. The pump priming system consists of two 24VDC electric primers. The pumping skid is furnished with a custom designed 14,000 GVW trailer from which it is easily removed for non-mobile or permanent installations. The trailer is equipped with four storage compartments, hose troughs for storage of (4) 10 ft. lengths of hard suction hose and (4) 6 in. lightweight basket type strainers.

Features

- May be used with either fresh or salt water.
- High capacity - 5000 GPM @ 150 PSI.
- Allows water pump to be moved to location where it is required thus eliminating the need for pressured water system.
- Suitable for use from draft or with portable pressurized water main.

Applications

The portable pump package can be used anywhere large volumes of water are required and a pressurized water source is not available or a water system is not capable of supplying adequate pressure.



Specification

The National Foam 5000 GPM Skid Mounted Diesel Pump consists of a Peerless 10AE20, cast iron, bronze fitted, horizontal split case pump with 12-Inch ASA Class 125 FF flanged suction connection and 10-Inch ASA Class 250 FF flanged discharge connection. The pump is designed for operation at a nominal capacity of 5000 GPM flow at 150 PSI discharge pressure while operating at a six-foot suction lift through six (6) six-inch internal diameter suction hoses and strainers. Two (2) Hale Model ESP 24VDC self-lubricating, rotary vane-type positive displacement electric primers will be provided with controls located at the pump operator's panel. Pump shall be driven by a Caterpillar Turbocharged engine. Power at flywheel is 600 BHP/447 kW @ 1900 RPM. All ratings are at SAE Standard J1995 Conditions, 29.31 in. (7521 mm) Hg barometric pressure, and 77°F (25°C) inlet air temperature. Cooling system shall consist of an engine mounted multi-row flat fin and tube radiator with pusher type fan. It shall have a single 6-inch (150 mm) exhaust with industrial grade silencer. Electrical system shall be 24VDC and shall include a 115 AMP alternator and two (2) batteries.

The pump operator's panel is located on the left side of the pump skid well forward of the suction manifold at a height readily accessible from ground level, but well clear of any suction or discharge. The operator's panel contains all controls for starting and stopping the engine, monitoring engine functions, priming the pump, and monitoring pump suction and discharge pressures. Controls shall include OFF-ON-START switch, tachometer, engine oil pressure gauge, engine coolant temperature gauge, voltmeter, suction (compound) gauge (4½-in. [114 mm], 30" - 0 - 400 PSI [762 mm - 0 - 2758 kPa]), left and right side work lights with switch, vernier engine throttle control, discharge gauge (4½-in. (114 mm), 0 - 400 PSI [0 - 2758 kPa]), and priming pump valve/switch control.

The suction manifold shall be constructed from 12-inch (300 mm), Schedule 10, stainless steel pipe and shall be complete with six (6) 6-inch (150 mm) National Hose thread (NH) Male brass suction connection adapters with inlet screens and brass 6-inch (150 mm) National Hose thread (NH) caps. Each suction connection shall be angled down 15 degrees from horizontal to reduce stresses on suction hoses. One ¾-inch (19 mm) valve is furnished for draining the manifold. The discharge manifold shall be constructed from 10-inch (250 mm), Schedule 10, stainless steel pipe and shall be complete with one (1) 2½-inch (63 mm) male National Hose Thread (NH) discharge with valve and five (5) 5-inch (125 mm) Storz discharges with valves. The 2½-inch and 5-inch discharges shall be angled down 10 degrees from horizontal to reduce stresses on hoses. One ¾-inch (19 mm) valve is furnished for draining the manifold.

The pump and engine are directly mounted to a steel skid base, which also serves as a fuel tank. The tank has an actual capacity of 380 gallons, however, due to allowances for a sump area for accumulation of moisture and sediment, and an expansion area, the usable capacity of the tank is approximately 300 gallons, which allows for at least 10 hours of operation at full load without the need for refueling. The tank is furnished with a fuel fill connection at the back end of the tank and is vented to allow for easy refueling while in use. The tank is furnished with ½" high base pads located under the tank to prevent the tank bottom from having direct contact with the ground if the skid is removed from the trailer. A tank drain is furnished at each end of the skid. The tank top has a drip pan with drain openings at each corner to catch any fuel spills that might occur during refueling. A forged steel "D-Ring" is furnished at each corner of the tank frame for shackle attachment. Devices intended to provide for operator's access to the trailer are equipped with a slip resistant surface in the step area. Top of side compartments shall have hose troughs for storage of the four hard suction hoses.

The pumping skid is furnished with a custom designed 14,000 GVW trailer from which it is easily removed for non-mobile or permanent installations. The trailer shall have dual axles with single wheels and 24VDC electric brakes (front and rear). The hitch shall be a Holland or equal, 2½–inch bolted adjustable draw bar coupler. Lighting shall consist of two 24VDC work lights on each side, two 24VDC rear lamps (brake and turn combination), 24VDC marker lights in accordance with U.S. DOT Standard 108, one 24VDC license plate light, and two rear 24VDC back-up lights. Trailer shall include front jack with 7,000-pound rating and top-wind drop-leg and shall have four storage compartments.

The trailer assembly shall be prepared, primed and painted with black polyurethane enamel. A reflective stripe shall be applied to the perimeter of the trailer. All suction and discharges connections 6-inch and smaller shall have caps or plugs. Two (2) wheel chocks shall be provided. The complete Pump/Driver will be tested and certified by National Foam, Inc. to meet the performance advertised for the assembly.

Technical Data

Pump: .... Peerless 10AE20, cast iron, bronze fitted, horizontal split case pump, 12" ASA Class 125 FF flanged suction x 10" ASA Class 250 FF flanged discharge, rated at a nominal capacity of 5000 GPM @ 150 PSI while operating at a six-foot suction lift. Pump shall have electric priming system.

Driver: .... Caterpillar C-16 Turbocharged diesel engine. Power at flywheel is 600 BHP / 447 Kw at 1900 RPM. All ratings are at SAE Standard J1995 Conditions, 29.61 in. (7521 mm) Hg barometric pressure, and 77°F (25°C) inlet air temperature.

Exhaust: .... Single 6" with industrial grade silencer.

Fuel: .... Approximately 29 gallons per
Consumption hour (110 liters) at run out (6000 GPM @ 120 PSI @ 1900 RPM).

Fuel tank: .... 300 Gallon (10 hour supply at rated flow).

Operators Panel: .... All controls for starting and stopping the engine, monitoring engine functions, priming the pump, and monitoring pump suction and discharge pressures.

Trailer: .... Custom designed.

GVWR: .... 14,000 lb (6,364 Kg).

Suspension: .... Dual Axle with 9.50 x 16.5 tires, highway tread, load range E.

Brakes: .... 24VDC electric, front and rear.

Hitch: .... Holland or equal, 2½–inch bolted adjustable draw bar coupler.

Lights: .... Two 24VDC work lights on each side, two rear lights (brake/turn combination), one license plate light, two back-up lights and markers in accordance with U.S. DOT Standard 108.

Connections:

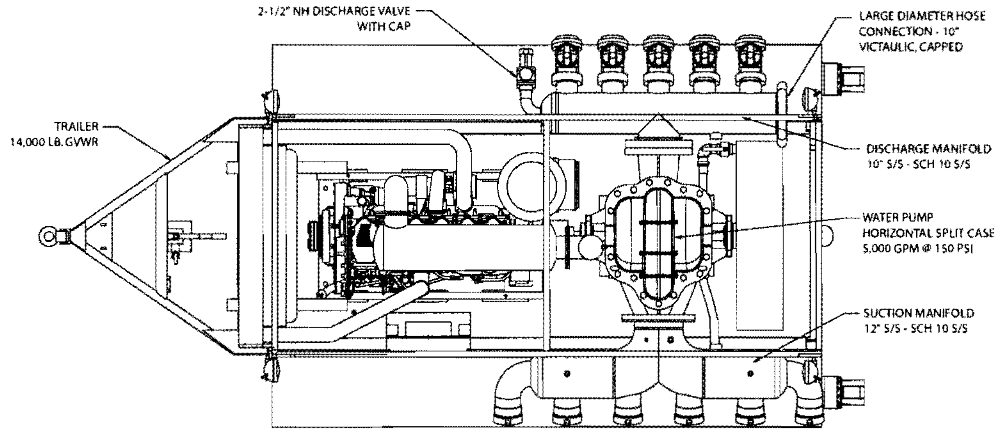
Suction: .... (6) 6-inch (150 mm) Male National Hose thread (NH) suction connection with inlet screens.

Discharge: ....
- (5) 5-inch (125 mm) Storz discharges with valves.
- (1) 2½-inch (63 mm) male National Hose Thread (NH) discharge with valve.
- 10-inch Victaulic

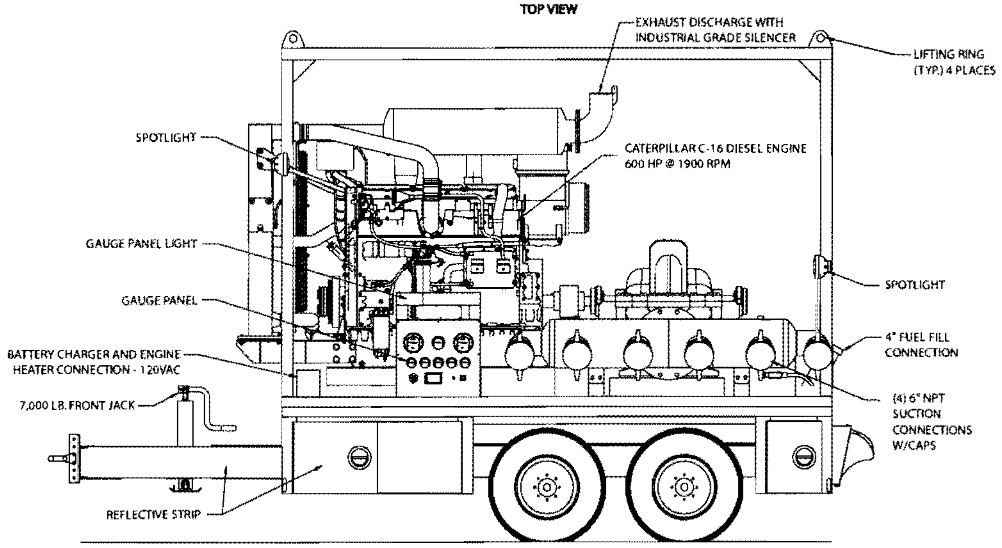
Finish: .... Polyurethane enamel. A reflective stripe shall be applied to the perimeter of the trailer. Standard color is red, other colors optional.

Options

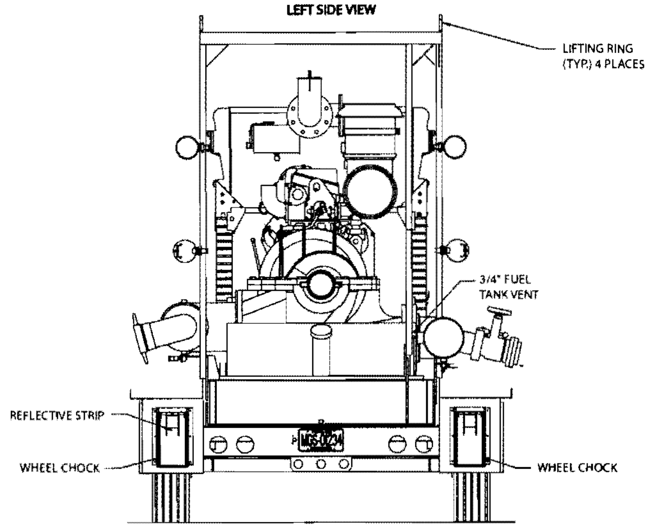
- Colors other than red.
- Custom suction and discharge connections and configurations, including grooved connections for large diameter hose and special hose threads.
- Suction Hose Kit: Includes (4) 10-foot lengths of PVC lightweight, black, ridged helix with smooth bore, for unrestricted flow, and lightweight M x F couplings. Each hose shall have a 6-inch basket type lightweight strainer.
- Manual Hand Primer System, consisting of (2) manual diaphragm primers, for use as a back-up to on-board electric priming system.



TOP VIEW



LEFT SIDE VIEW



REAR VIEW

This information is only a general guideline, and each installation may require modifications to meet the applications or requirements of that situation. The company reserves the right to change any portion of this information without notice. Terms and conditions of sale apply and are available on request.

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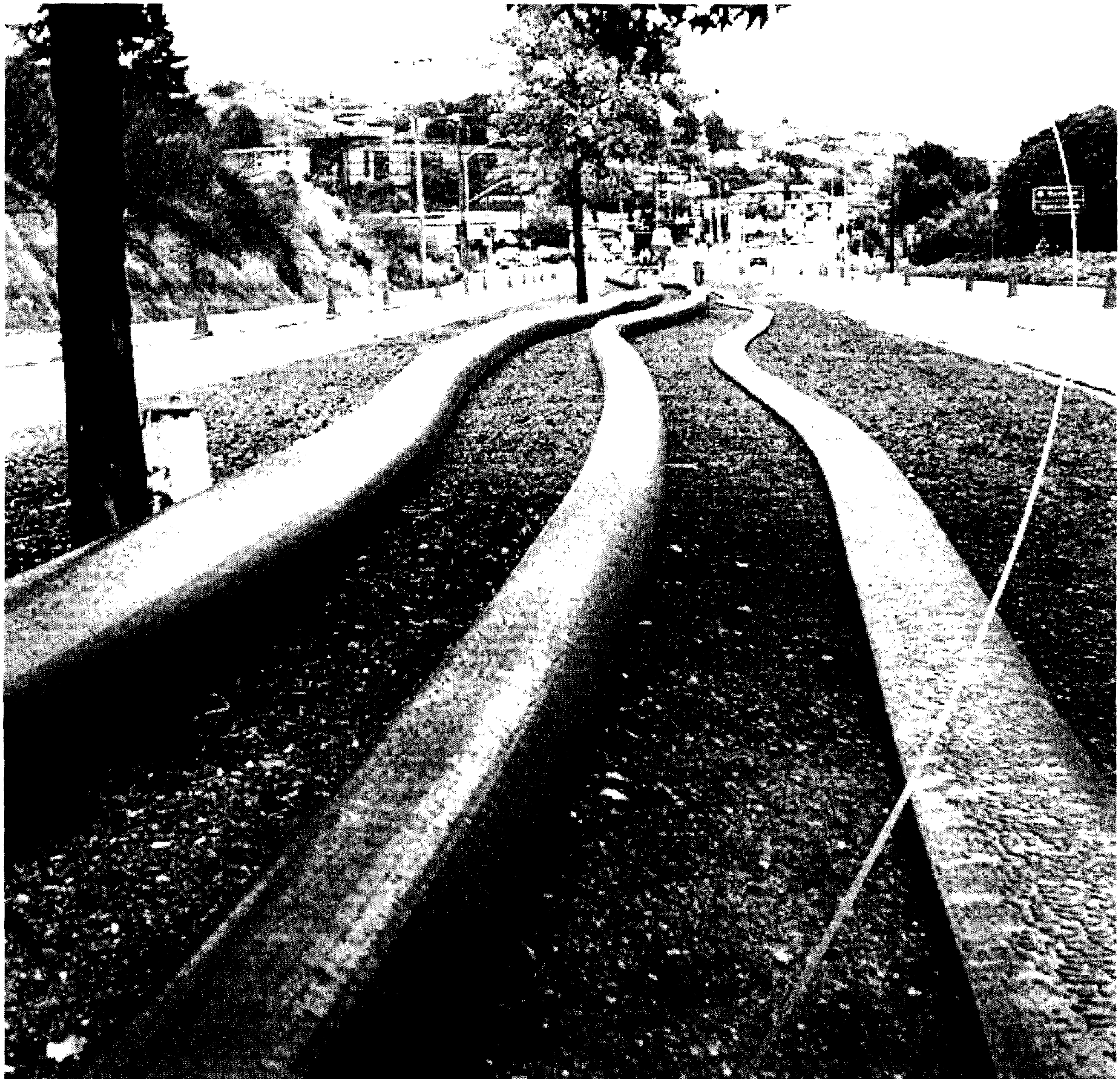
ANGUS
Flexible Pipelines



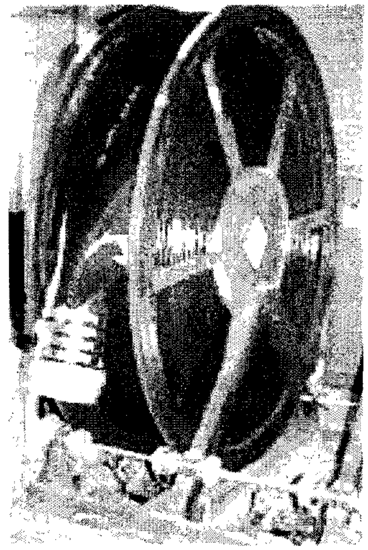
Kidde Fire Fighting

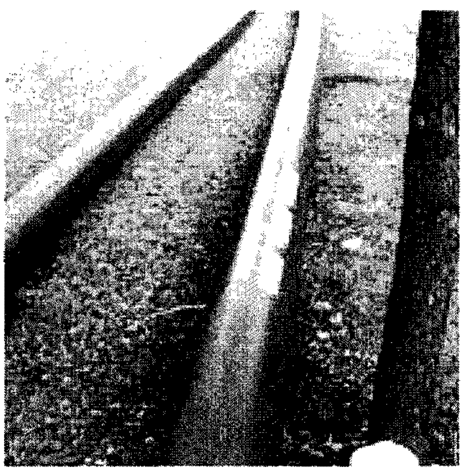
Today's water management professionals face complex operational, maintenance, and security challenges in the distribution of our nation's potable water supply.

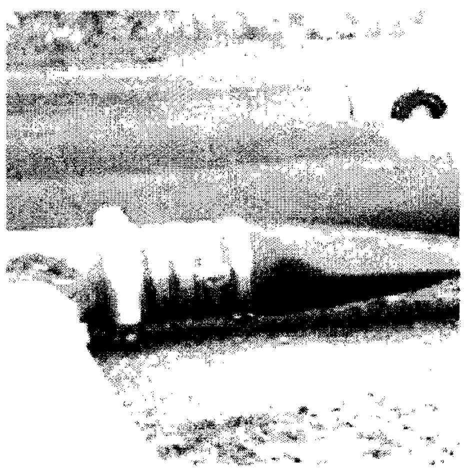
- Aging infrastructure integrity and maintenance
- Water quality
- Regulatory compliance
- Varying customer service requirements
- Mutual aid responsibilities
- Natural disasters
- Fire fighting support requirements

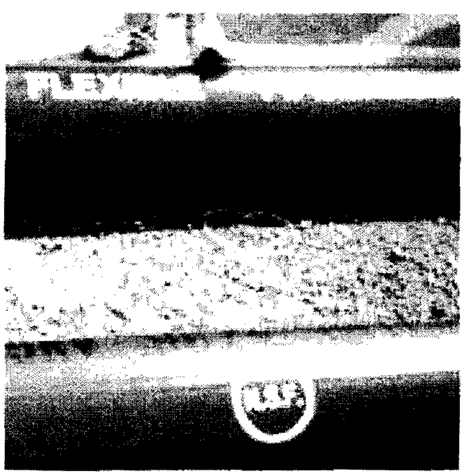
Now, a new challenge has arisen: the threat of terrorism, including loss of underground distribution systems or contamination of reservoirs. Now even more is demanded of water professionals responsible for infrastructure protection and contingency planning.

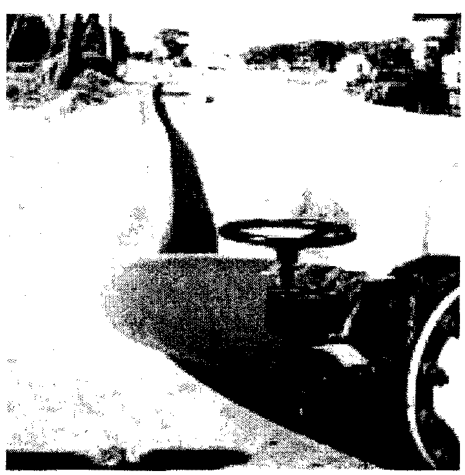
Every facet of the "Water Lifeline" must be reviewed, analyzed and scrutinized. Every technology to move water must be considered including by-pass, above ground systems.

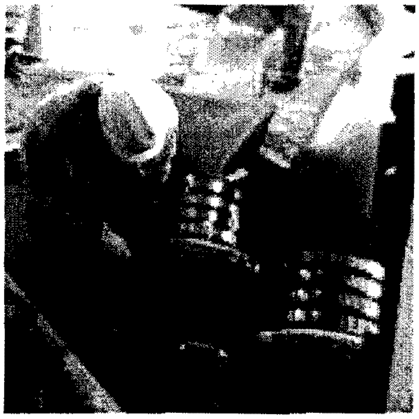




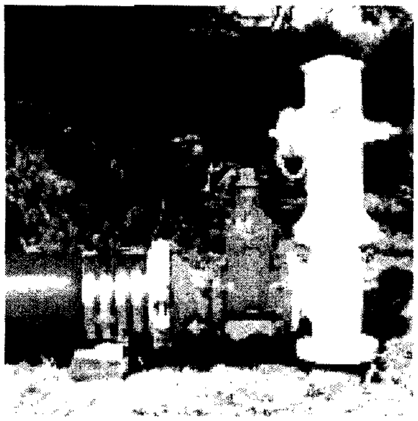






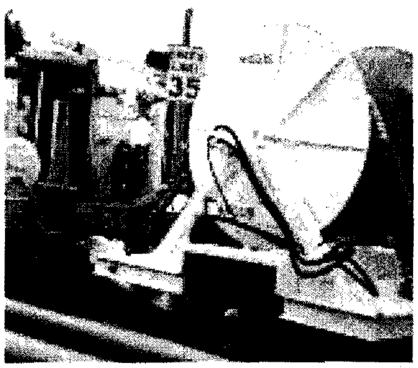


Super Aquaduct end connectors and manifolding components are simple to use, allowing the operator to easily connect multiple sections of conduit, along with facilitating the connection to fire hydrants, pumps, valves, storage tanks, and pipe work.

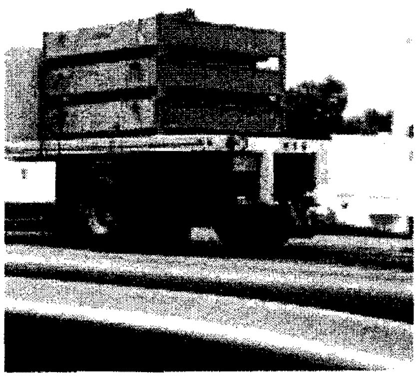


Manifolds provide additional, mobile distribution flexibility when "laterals" are required to supply domestic service, distribution points, fire operations support, or other distribution systems.

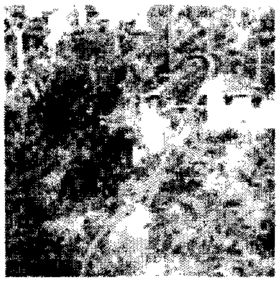
Operators or municipalities may custom design their own system, choosing from several options within each component group or create a design for the exact configuration their districts will need.



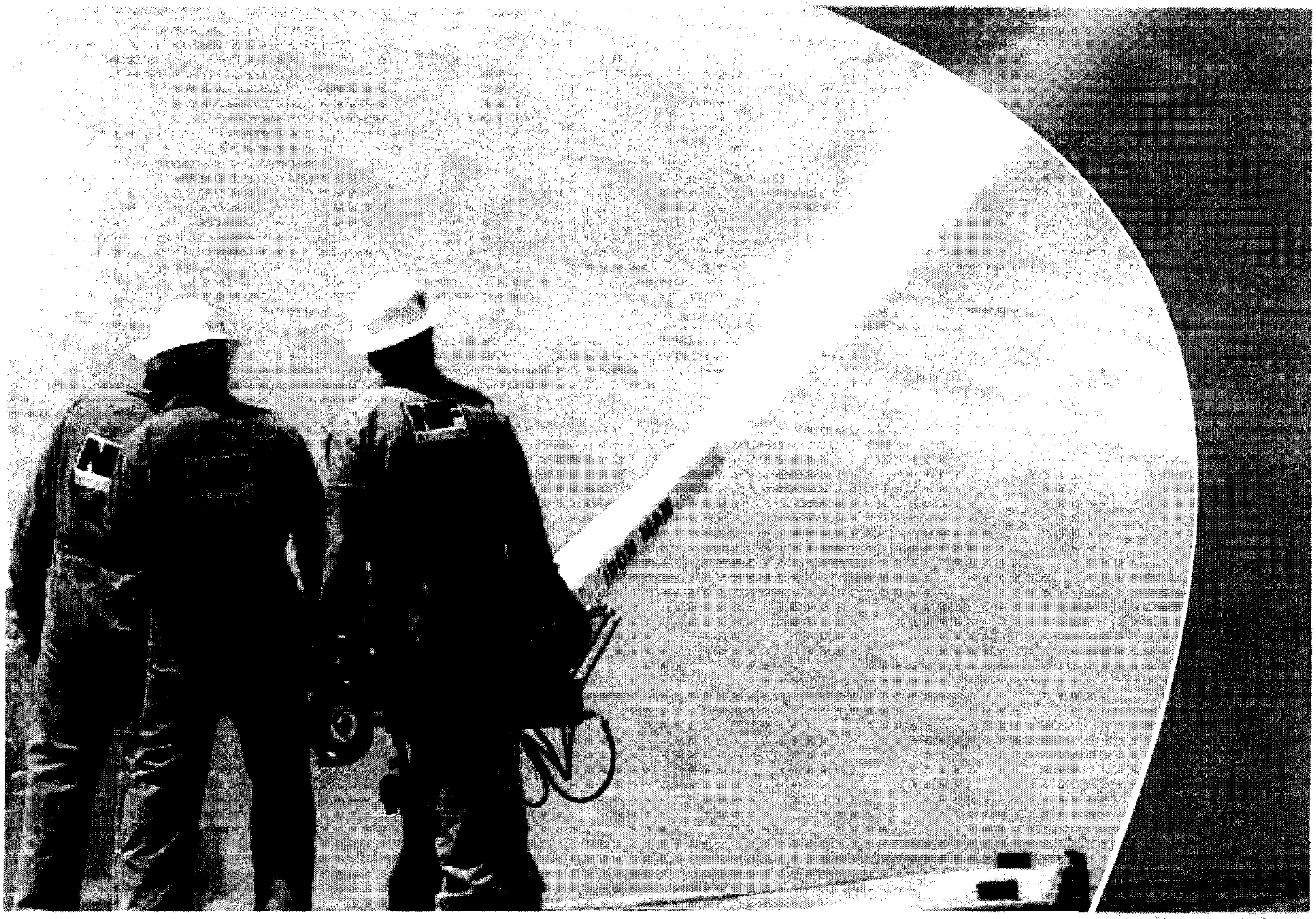
Our custom-engineered equipment is designed to meet each water authority's operational requirements and pipeline specifications. This gives operators the ability to deploy, retrieve and store individual sections of a miles-long pipeline system.



A wide variety of trailers, reels, and "flaking" boxes can be designed for any configuration and number of pipeline assemblies. Both skidmounted and towable packages are available for rapid deployment and retrieval operations. They allow the operator to minimize personnel and equipment needed to place the pipeline.



Kidde Fire Fighting

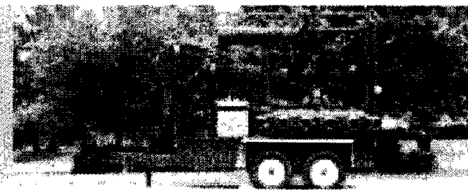


A combined high capacity foam delivery solution providing power and performance from National Foam and Angus Fire.

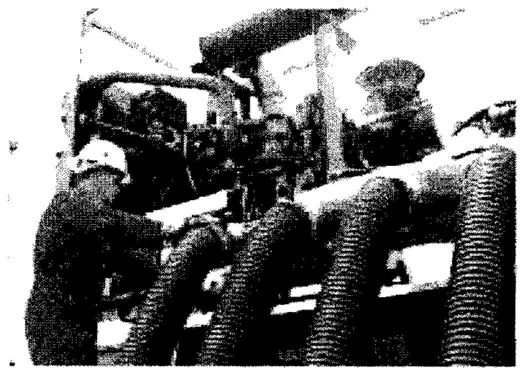
ANGUS FIRE

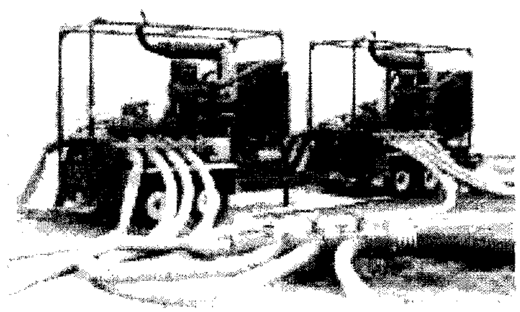
NATIONAL FOAM

Dominator

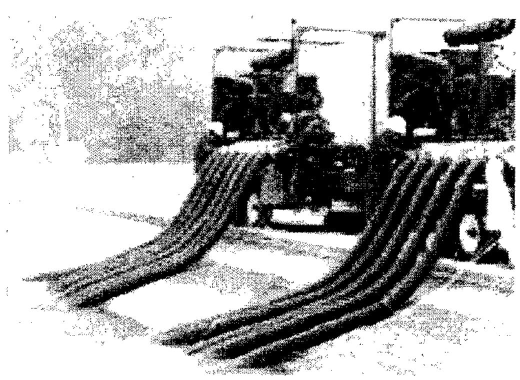


The National Foam Dominator 5000 GPM skid mounted diesel pump trailer answers the need for a large, practical, and efficient fire water pump. The unit has a nominal performance rating of 5000 GPM at 150 PSI when operating with a 6 ft. suction lift. The pump and engine are mounted on a box frame base, which also serves as a 300 gallon fuel tank. The stainless steel suction manifold is well outfitted with (6) 6" NH connections. The stainless steel discharge manifold is extremely capable for water distribution with (5) 5" Storz connections, (1) 10" Vic connection, and (1) 2 ½" NH valved discharge. The unit is equipped with an operator's panel for engine controls and manifold pressure gauges. The pump's electrical system is 12 VDC with two heavy-duty batteries. The priming system consists of two 12 VDC electric primers. The pump skid is mounted on a custom designed 14,000 GVW trailer from which it can be utilized or easily removed for non-mobile or permanent applications. The standard unit is complimented with an overhead frame for lifting and hard suction hose troughs.

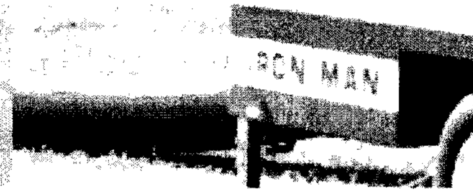




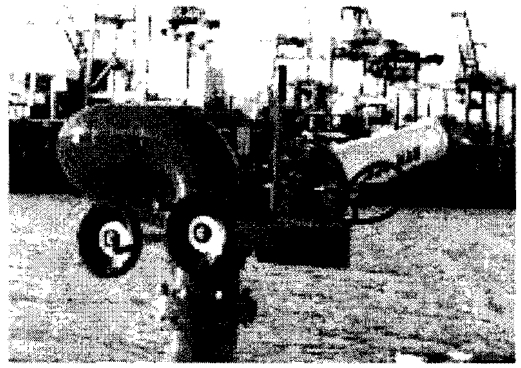
- High capacity 5000 GPM @ 150 PSI from draft
- Capacities much greater than 5000 GPM from adequate pressurized water sources
- Suitable to establish and/or supplement water supply needs
- May be used with both fresh and seawater

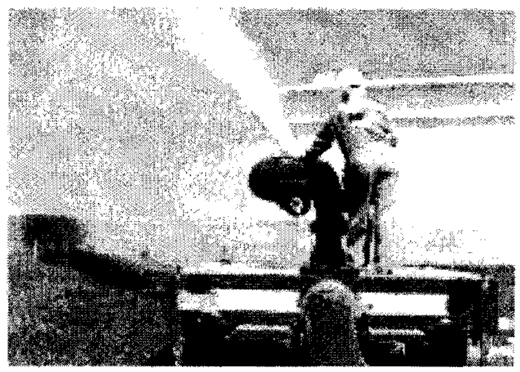


- Any paint color
- Custom suction and discharge connections and configurations
- Suction hoses and accessories
- Storage compartments
- Other GPM units available

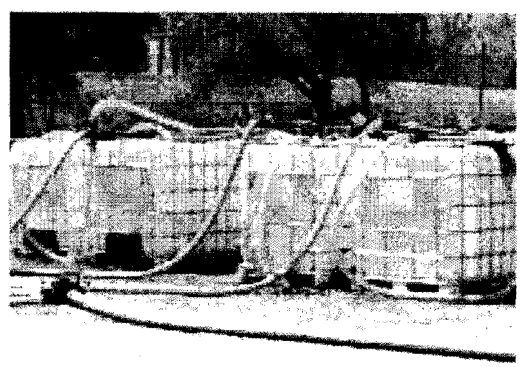


The National Foam Iron Man 8000 GPM high capacity mobile foam delivery device offers outstanding performance. Ironman proves its versatility and superiority with excellent foam stream quality, ranges in excess of 450 ft., 340° of free rotation and a +15° to 90° range of elevation. Iron Man utilizes a specially engineered non self-educting nozzle that offers a foam expansion ratio of 6.6:1 creating an efficient foam stream better suited for penetrating thermal updrafts encountered during large scale fires. The nozzle delivers 8000 GPM at a nominal pressure of 115 PSI. The stainless steel monitor, fed by a single 12" Victaulic or Storz hose connection, is mounted on a custom built trailer which when filled with water, acts as the unit stabilizer during operation. Iron Man is supplied with a 'pony tail' 25 ft. length of 12" Super Aquaduct hose as standard with a 12" inlet manifold that may be configured to (6) 6" or 5" Storz connections, offering immense flexibility in water supply.



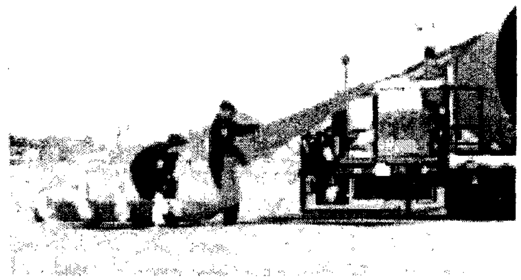


- Outstanding foam stream range.
- Superior quality foam stream with minimal fallout.
- Immense monitor movement flexibility.
- Hydraulically operated stream pattern changer from straight stream to semi-fog.
- Compatible with all major types of foam concentrate.
- Variable GPM Tip Kit available.

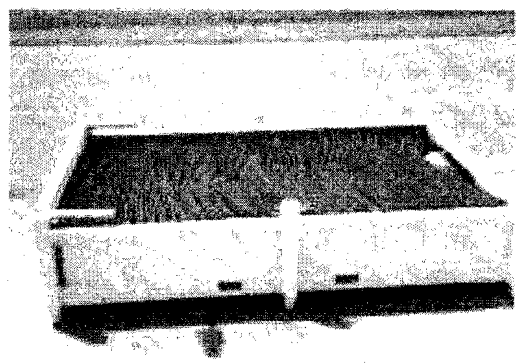


The simplest method of introducing foam in to the Iron Man water flow is through the use of jet pumps. A configuration of (2) 3000 GPM and (1) 2000 GPM National Foam jet pumps, for 3% or 6% foam, proportioning provides an effective solution at a total flow of 8000 GPM. Key benefits of using jet pumps are improved logistics and greater flexibility offered in positioning your foam station.

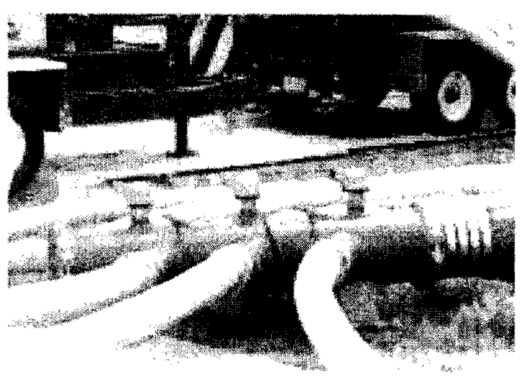
This equipment, from Angus Fire, is custom engineered and allows the operator the capability to deploy, retrieve and store Super Aquaduct. A variety of trailers, reels, and flaking boxes can be designed for any configuration and number of "flexible pipeline" assemblies. Skid mounted, truck mounted as well as towed equipment configurations are available.



A complete line of end connectors and manifolds are available. These components allow operators to connect multiple sections of Super Aquaduct as well as connect with fire hydrants, fire water systems, fire fighting and water transfer equipment.



Super Aquaduct is a specialized polyurethane hose, which is extruded through the weave cover and lining, and is reinforced with circular woven high tenacity polyester. Super Aquaduct is the only product of its kind which is NSF 61 certified for potable water. This hose was designed for a variety of above ground high flow potable or fire water contingencies. Available in blue and orange.



Size		Max Working Pressure**		Burst Pressure		Weight* per foot	
inch	mm	psi	kPa	psi	kPa	lbs.	kg
6	152	300	2100	600	4200	1.09	0.5
8	203	220	1540	500	3500	1.9	0.86
10	254	150	1050	400	2800	2.2	1
12	305	150	1050	300	2100	3.1	1.41

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B.2 Rain For Rent Example Pump Package

Example RainForRent Products

The following packages represent products currently available from RainForRent. These packages represent examples of systems that would generally be expected to meet or exceed the general requirements at most sites. RainForRent currently has a contract in place with a nuclear utility to provide emergency response capability. RainforRent has approximately 36 diesel driven pump designs, plus specialty pumps (e.g., submersible) and the capability to custom design and manufacture pumps for specific applications. RainForRent has regional offices and field representatives who can provide consultation to ensure site specific attributes and needs are considered. More product information is available at www.RainForRent.com. The initial point of contact is Chris Schill (Branch 31).

Name	Chris Schill
Title	Sr. Sales Representative
Phone	(661) 399-6307
Email	cschill@rainforrent.com
Address	4001 State Road Bakersfield, Ca 93008

Cost estimates listed below are at list price. Each system should be custom designed to meet facility specific requirements.

Base System (200 to 500 gpm)

Pump Options

- Model DV-100 (4" X4" continuous self-priming pump, high flow low head max gpm 820 max head 115ft. Suction lift to 28', list price $21,910.00)

- Model HH-80 (3" X3" continuous self-priming pump, Med flow high head max gpm 450 max head 300ft. Suction lift to 28', list price $21,118.00)

Hose/Pipe Options

- Type 4" grooved aluminum with 2 fittings and couplings ($ per 100' 962.00)
- Type 4" X 50' 120psi layflat with couplings and 2 fittings ($ per 100' 1,521.00)
- 4" X 25' suction hose ($107.00)

Monitor Nozzle Options

- 2.5″ Stang monitor with shapertip nozzle ($2,166.00)
- Rolling cart ($5,500.00)
- Other monitor options are available (e.g., oscillating)

Enhanced System 1

Pump

- *Power Prime HH-125* skid/trailer mounted diesel pump providing up to 900 gpm ($30,290.00 approximate cost)

Hose/Pipe

- Custom selected for high pressure and high flow (cost priced upon system design)

Monitor Nozzle

- Models from 2.5″ to 4″, nozzle delivers from 150 to 2000 gpm at 120 psi, with a range of elevations ($850.00 to $4,000)
- Other monitor options are available (e.g., oscillating)

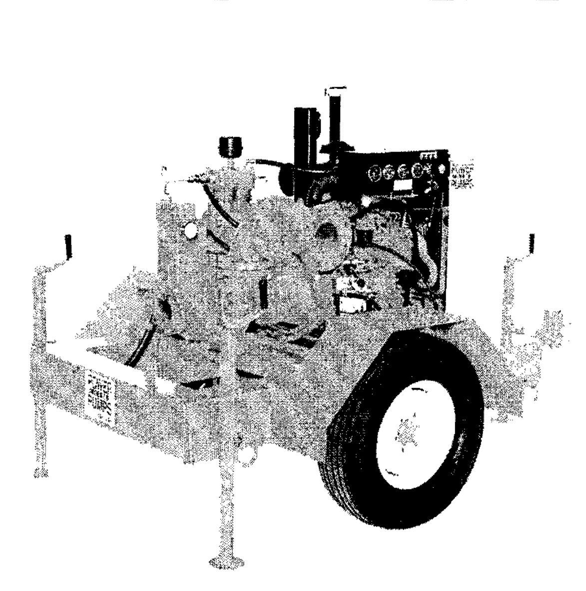
Enhanced System 2

Pump

- *Power Prime XH-100* skid/trailer mounted diesel pump provides 300 gpm to 1,200 max gpm at max 260 psi. ($99,710.00)

Hose/Pipe Cost estimate priced upon system design only
Monitor Nozzle Cost estimate priced upon system design only

POWER PRIME PUMPS



DV-100 Vacuum Assist Self-Priming Pump

DV-100

SIZE 4" x 4"

- 800 GPM MAX
- 115 FT HEAD MAX

POWER PRIME PUMPS™

FEATURES

- Solids handling capabilities to 2-¼" diameter maximum
- Continuous self priming
- Runs dry unattended
- Suction lift to 28'
- Skid or trailer mounted
- Stainless Steel Pump Options

TECHNICAL

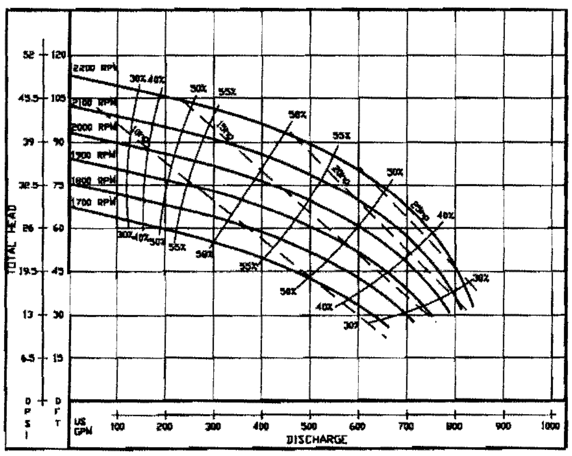
- The DV-100 is direct coupled to a John Deere 3015D or 4020D diesel fueled engine.
- The pump and engine are skid or trailer mounted with lifting bracket and integral 24-hour minimum capacity fuel tank.
- The engine is 12 volt, electric start.
- The compressor is fitted to operate the air-ejector priming system.
- Other makes of diesel engines and electric power options are available.

MATERIAL SPECIFICATIONS

- Standard build is 316 stainless steel open impellers and replaceable wear plates.
- Pump shaft is 431 stainless steel. All other major pump components are spheroidal graphite iron.
- The mechanical seal, with solid silicon carbide mating faces, is lubricated in an oil bath.
- Suction and discharge flanges are 4" ANSI 150# FF.

Performance Curve for DV-100

Flows Indicated Are At 10' Suction Lift In Clean Water



Flows given in American Gallons Per Minute

Fuel consumption: 1.3 GPH @ 2,200 RPM

PPP-DV100-250-01/00

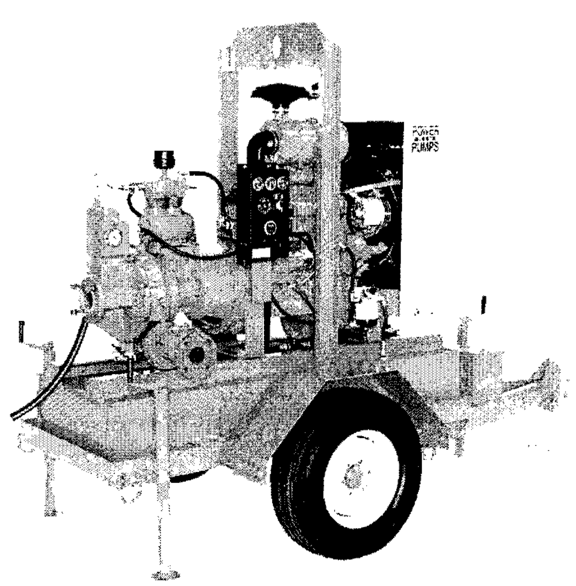
POWER PRIME

www.powerprime.com • sales@powerprime.com

PO Box 2248 • Bakersfield, CA 93303-2248

(800) 647-7246 • (661) 399-9058 • FAX (661) 399-3374

POWER PRIME PUMPS



HH-80 Vacuum Assist Self-Priming Pump

HH-80

SIZE 3" x 3"

- 450 GPM MAX
- 300 FT HEAD MAX

POWER PRIME PUMPS™

FEATURES

- Solids handling capabilities to 1" diameter maximum
- Continuous self priming
- Runs dry unattended
- Suction lift to 28'
- Skid or trailer mounted
- Stainless Steel and CD4MCu* Pump Options

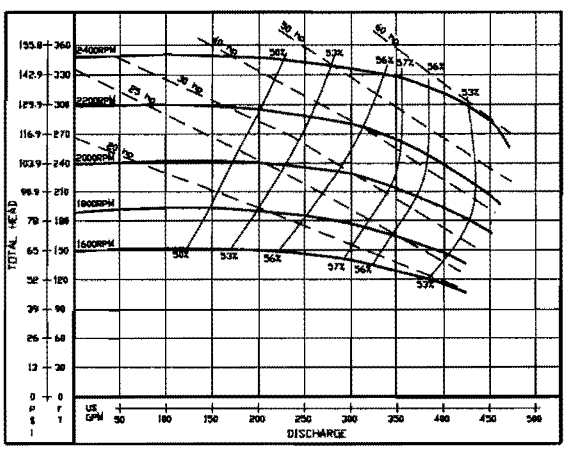
TECHNICAL

- The HH-80 is close-coupled to a John Deere 4039D or 4045D diesel fueled engine.
- The engine is 12 volt, electric start.
- The pump and engine are skid or trailer mounted with lifting bracket and integral 24-hour minimum capacity fuel tank.
- Belt-driven compressor is fitted to operate the air-ejector priming system.
- Other makes of diesel engines and electric power options are available.

MATERIAL SPECIFICATIONS

- Standard build is 316 stainless steel open impellers and replaceable wear plates.
- Pump shaft is 431 stainless steel. All other major pump components are spheroidal graphite iron.
- The mechanical seal, with solid silicon carbide mating faces, is lubricated in an oil bath.
- Suction and discharge flanges are 3" ANSI 150# FF.

Performance Curve for HH-80
Flows Indicated Are At 10' Suction Lift In Clean Water



Flows given in American Gallons Per Minute

**CD4MCU is an alloy highly resistant to corrosion and abrasion*

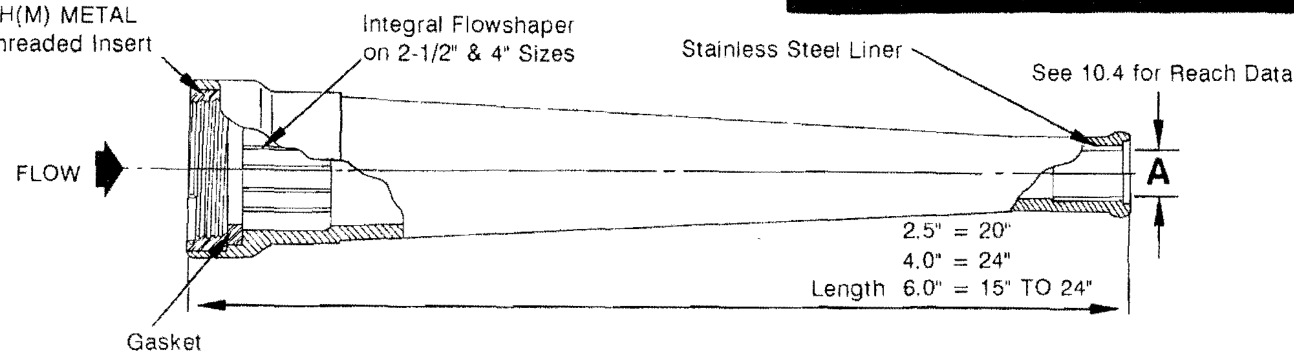
Fuel consumption: 3.63 GPH @ 2,200 RPM

PPP-HH080-10M-01/00

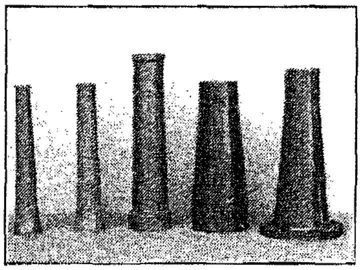
POWER PRIME
www.powerprime.com • sales@powerprime.com
PO Box 2248 • Bakersfield, CA 93303-2248
(800) 647-7246 • (661) 399-9058 • FAX (661) 399-3374

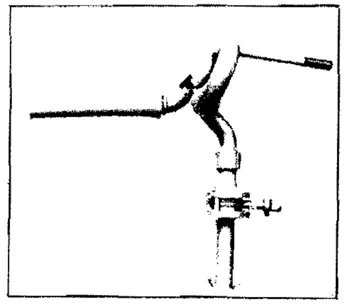
MAX REACH
STANG
SHAPERTIPS®

COMPUTERIZED REACH PERFORMANCE DATA AVAILABLE TO ANALYZE YOUR SPECIFIC APPLICATION



MAXIMUM "EFFECTIVE" REACH AVAILABLE





DIRECT COMPARATIVE SITE TESTS INVITED

2.5" NH Nozzle 7# Weight			4.0" NH Nozzle 16# Weight+			6.0" Nozzle 15# Weight*		
Part Number	A Orifice Dia.*	Flow-GPM @ 100 PSI	Part Number	A Orifice Dia.*	Flow-GPM @ 100 PSI	Part Number	A Orifice Dia.*	Flow-GPM @ 100 PSI
100228-20	2.000	1080	101230-30	3.000	2,600	105000-45	4.500	5,900
100228-18	1.875	975	101230-27	2.750	2,200	105000-42	4.250	5,300
100228-17	1.750	870	101230-25	2.500	1,800	105000-40	4.000	4,700
100228-16	1.625	760	101230-22	2.250	1,500	105000-37	3.750	4,100
100228-15	1.500	640	101230-20	2.000	1,150	105000-35	3.500	3,600
100228-13	1.375	540				105000-32	3.250	3,100
100228-12	1,250	445				105000-30	3.000	2,600
100228-11	1.125	360						
100228-10	1.000	285						
100228-08	.875	220						
100228-07	.750	160						

\+ **Stainless steel inlet threads**

* **Special diameters available upon specific request**

NOTE: 6" ARE ALL STAINLESS STEEL CONSTRUCTION WITHOUT FLOW STRAIGHTENERS

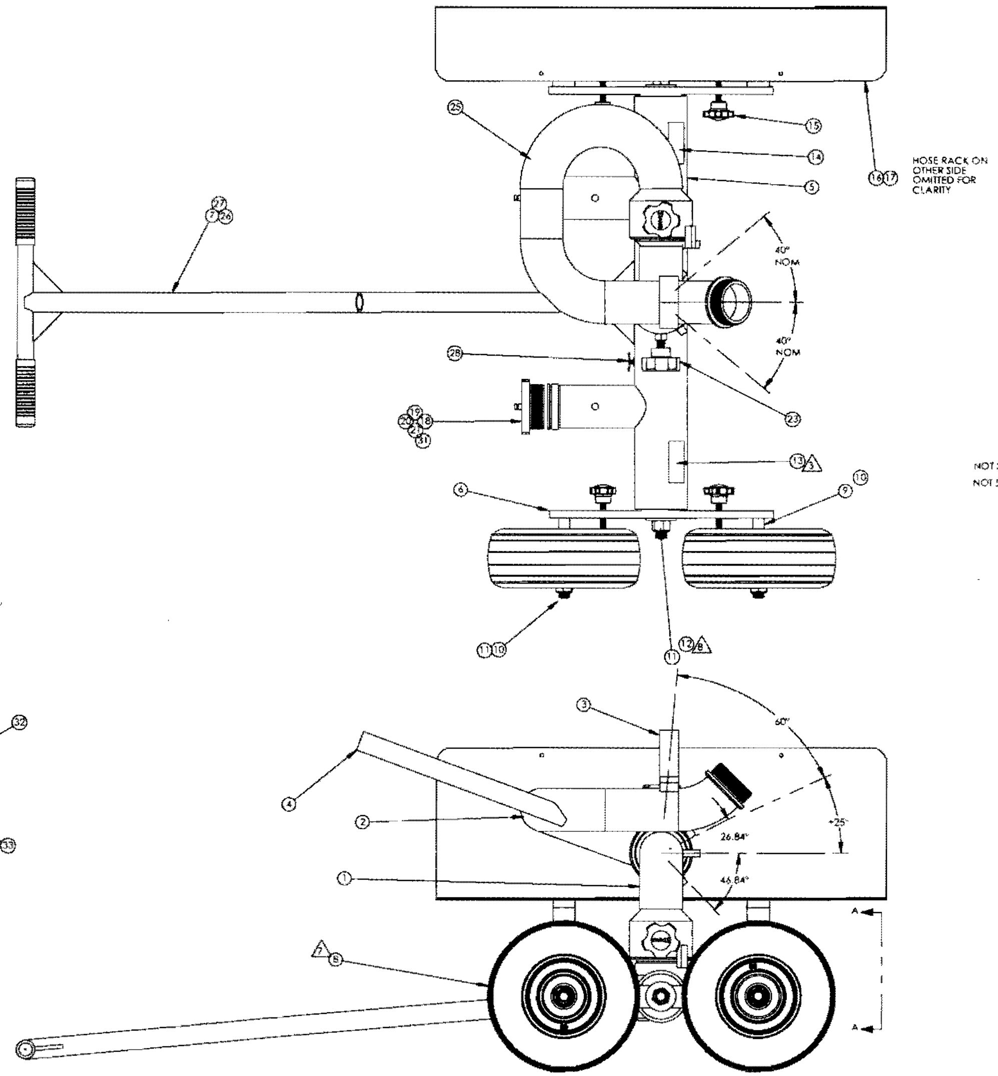
Stang Industrial Products
16692 Burke Lane
Huntington Beach, Ca. 92647
(714) 556-0222
Fax (714) 546-8017

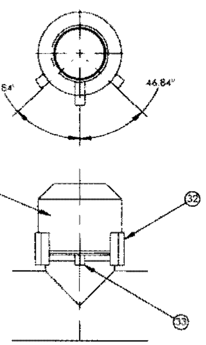
A DIVISION OF GST Industries, Inc.

NOTES: (UNLESS OTHERWISE SPECIFIED)

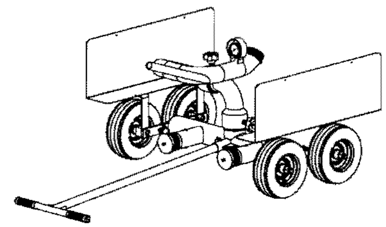
1. DO NOT SCALE THIS DRAWING
2. REMOVE BURRS AND SHARP EDGES
3. IDENTIFY WITH MODEL & SERIAL NO
4. -1 POLYESTER POWDER COAT; -11 EPOXY POWDER COAT
5. WHEEL/BOGIE KIT (SHEET 2)
6. OPTIONAL TO BE SPECIFIED ON S O; QTY SAME AS FOR -11 WHEN REQUIRED
7. WHEEL/TIRE ASSY TO BE FILLED WITH POLY URETHANE FOAM PER A104503-1
8. ASSEMBLE BOGIE ONTO INLET MANIFOLD TO A FREE PIVOTING SNUGNESS
9. POSITION ITEMS 32 & 33 TO PROVIDE ±40° HORIZONTAL TRAVEL AND +25° MINIMUM VERTICAL TRAVEL AND +85° MAXIMUM VERTICAL TRAVEL
10. DELETE WHEN ITEM 17 WAS SPECIFIED ON S O
11. FOR MODEL -2(3 INLET AXLE) SEE VCN 100880-2C
12. FOR RETROFIT CONVERSION OF OLD 100460 CHECK VALVE TO NEW 2.5 INCH CHECK VALVE SEE A104705 & C104705-1
13. FOR QUICK RELEASE BRAKE OPTION SEE D105177

LTR	REVISIONS	DATE	BY	REF
AG	REDRAWN	01-30-98	RGP	





VIEW A - A



	QTY	QTY	PART NO	ITEM	NOMENCLATURE	MATERIAL
9	2	2	-C2	33	STOP .50 SQ X A/R	CRES
9	4	4	-C1	32	STOP .50 SQ X A/R	CRES
	2	6	P104137-25	31	2.5 NH PLUG & CHAIN	BRASS
NOT SHOWN	1	6	P103782-1	30	PROTECTIVE COVER (WITH HOSE RACK)	
NOT SHOWN	-	6	P103782-11	29	PROTECTIVE COVER (WITHOUT HOSE RACK)	
	1	6	A104388-1	28	PETCOCK DRAIN INSTALLATION (.125 NPT)	
	1	1	P100789-5	27	HITCH PIN .25 DIA X 1.75 GRIP	CRES
	1	1	P101809-3	26	CABLE ASSEMBLY	NYLON COATED STEEL
	1	1	A103645-1	25	WARNING LABEL	
	2	2	P100112-8	24	GREASE FITTING	
	2	2	C102537-1	23	LOCK KNOB	
	2	2	A103829-1	22	SWIVEL KIT	
	2	2	B102683-3	21	SWIVEL, 2.5-7.5 NH	BRASS
	76	76	B100349-1	20	SWIVEL DISC	BRASS
	2	2	P102194-1	19	PLUG, SOC HD .38 24 UNF-2A X .25 LG	BRASS
	2	2	B100275-1	18	GASKET	NEOPRENE
	2	6	D103106-21	17	HOSE RACK (ALT D104506-1 HOSE BOX RACK)	
	4	6	P100795-1	16	BUNGEE STRAP	
	4	4	B100983-1	15	LOCK HANDLE ASSEMBLY - WHEEL	
	1	1	B100751-1	14	INSTRUCTION LABEL	
	1	1	B100853-1	13	IDENTIFICATION LABEL	
	4	4	P101989-75	12	WASHER	
	6	6	P100249-13	11	LOCK NUT .75-10 UNC-2B (GREER TYPE)	CRES
	8	8	P101715-75	10	WASHER	
10	-	4	B100831-3	9	SPACER	
	4	4	A104503-1	8	TIRE & WHEEL ASSEMBLY 7	
	1	1	B100834-1	7	HANDLE ASSEMBLY	
	2	2	B100830-1	6	BOGIE WELDMENT	
	1	1	D100829-1	5	INLET WELDMENT (2 INLET)	
	1	1	P100256-8	4	GRIP	
	1	6	B103400-1	3	PRESSURE GAUGE & GUARD	
	1	1	D103316-111	2	UPPER ELL WELDMENT, 2.5 NOM	
	1	1	B101221-3	1	LOWER ELL WELDMENT, 2.5 NOM	
-101 5	-11	-1				

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES X ± .1; .XX .03; .XXX .010; ANGULAR ± 2°
ALL MACHINED SURFACES ARITHMETIC AVERAGE
HEAT TREAT
PROTECTIVE FINISH 4

STANG INDUSTRIAL PRODUCTS
DIV. OF GST INDUSTRIES INC
3601 W. CENTRAL AVE
SANTA ANA CA 92704

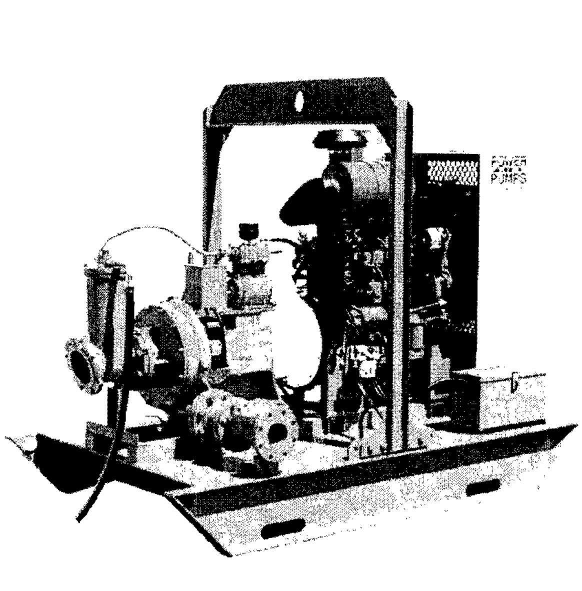
STANG FIREFLY
PORTABLE 4 WHEELED MONITOR, 2.5 NOM

FSCM NO	CUST NO	PROJ NO	SH	OF
55822	100880-1		1	2

DATE	DRAWN	CHECKED	DRAWING NO	REV
01-30-98	RGP		D100880	AG
SCALE NONE	DESIGN	APPROVED		

SUFFIX	QTY	NEXT ASSY	FINAL ASSY
-11	1		END ITEM
-1	1		END ITEM
	APPLICATION		

Power Prime PUMPS



HH-125 Vacuum Assist Self-Priming Pump

HH-125

SIZE 6" x 4"

- 800 GPM MAX
- 370 FT HEAD MAX

POWER PRIME PUMPS™

FEATURES

- Solids handling capabilities to 1.2" diameter maximum
- Continuous self priming
- Runs dry unattended
- Suction lift to 28'
- Skid or trailer mounted
- Stainless Steel and CD4MCu* Pump Options

TECHNICAL

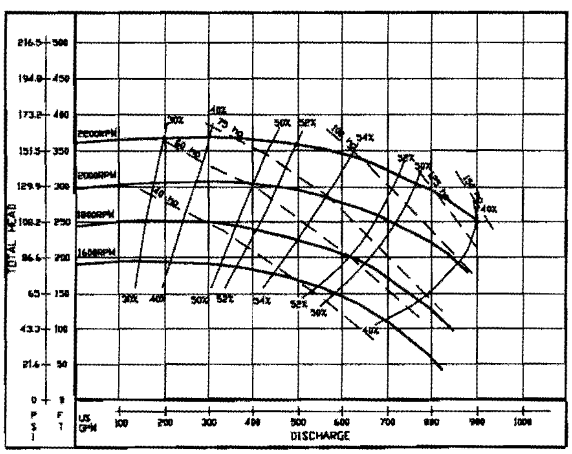
- The HH-125 is close-coupled to a John Deere 4045T diesel fueled engine.
- The engine is 12 volt, electric start.
- The pump and engine are skid or trailer mounted with lifting bracket and integral 24-hour minimum capacity fuel tank.
- The compressor is fitted to operate the air-ejector priming system.
- Other makes of diesel engines and electric power options are available.

MATERIAL SPECIFICATIONS

- Standard build is 316 stainless steel open impellers and replaceable wear plates.
- Pump shaft is 431 stainless steel. All other major pump components are spheroidal graphite iron.
- The mechanical seal, with solid silicon carbide mating faces, is lubricated in an oil bath.
- 6" suction and 4" discharge flanges are ANSI 150# FF.

Performance Curve for HH-125

Flows Indicated Are At 10' Suction Lift In Clean Water



Flows given in American Gallons Per Minute

**CD4MCU is an alloy highly resistant to corrosion and abrasion*

Fuel consumption: 5 GPH @ 2,200 RPM

PPP-HH125-10M-01/00

POWER PRIME
www.powerprime.com • sales@powerprime.com
PO Box 2248 • Bakersfield, CA 93303-2248
(800) 647-7246 • (661) 399-9058 • FAX (661) 399-3374

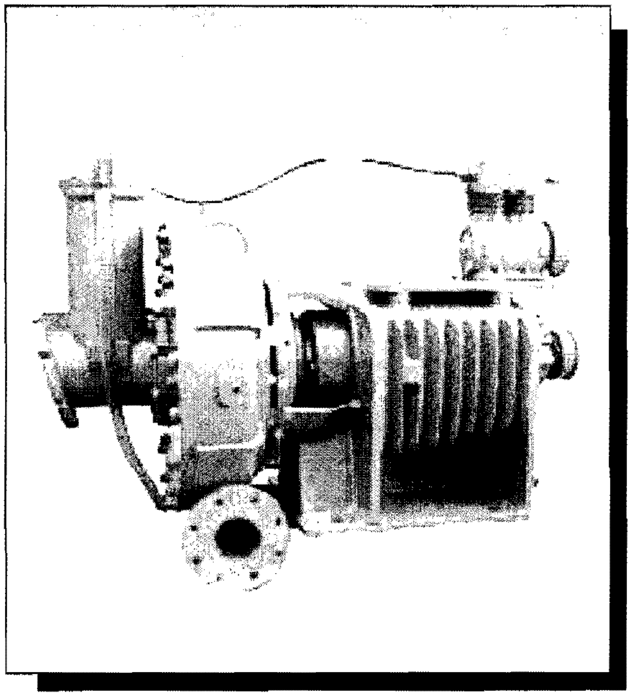
RAIN FOR RENT PUMPS

XH-100

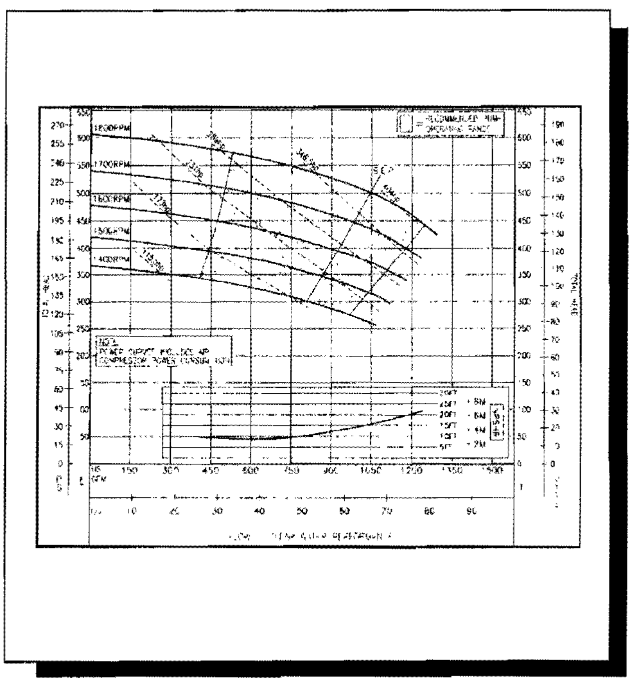
SIZE 6" x 4"

- 1,250 GPM MAX
- 605 FT HEAD MAX

POWER PRIME™ PUMPS



XH-100 Vacuum-Assist, Self-Priming Pump



XH-100 Performance Data

Fuel consumption: 12 GPH @ 1,800 RPM

FEATURES

- Solids-handling capabilities to 7/8" diameter maximum
- Continuous self-priming
- Runs dry unattended
- Suction lift to 28 ft.
- Skid- or trailer-mounted
- Stainless Steel, CD4MCu and Chrome pump options

TECHNICAL

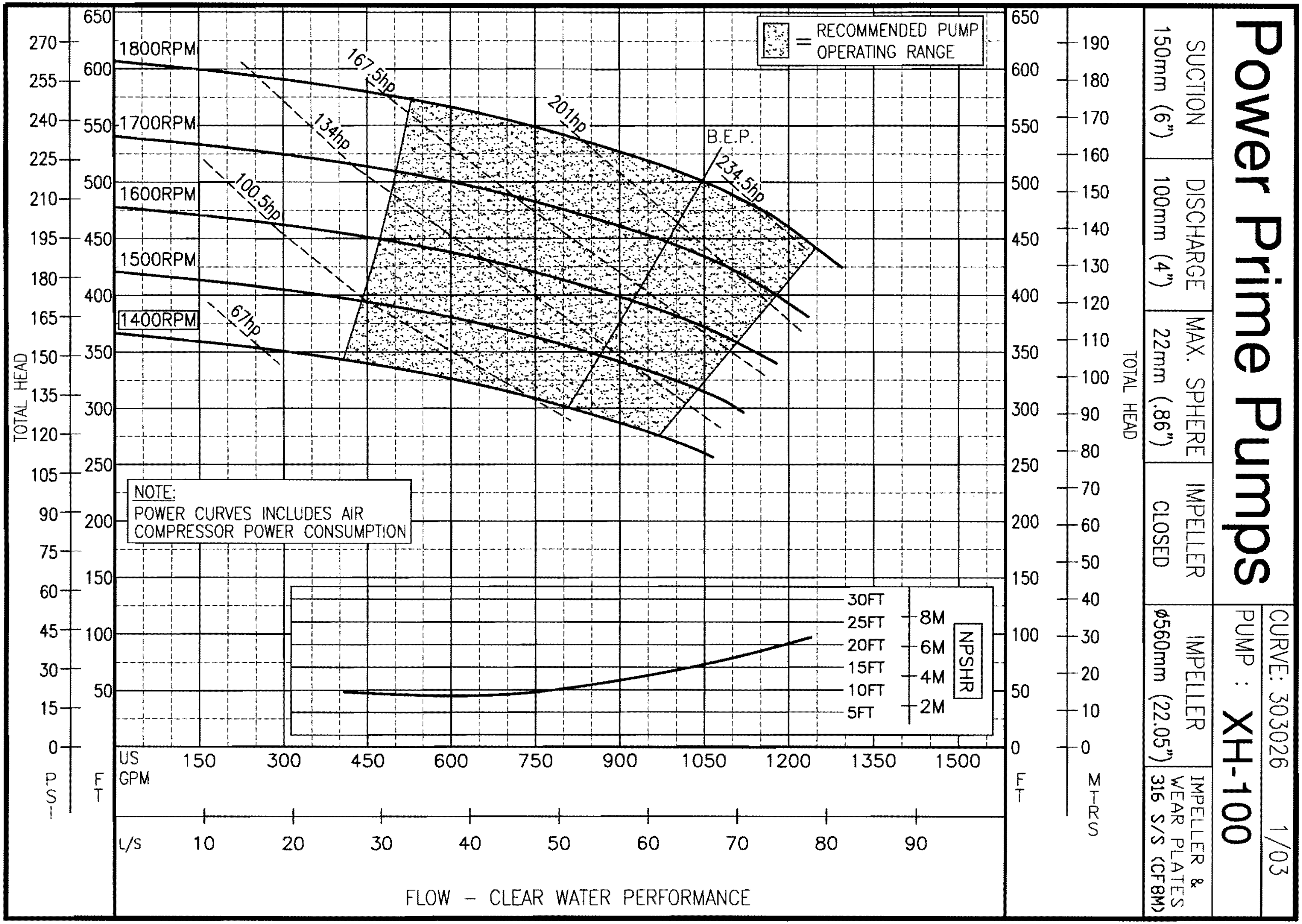
- Pedestal-mounted
- Flex coupled to various diesel engines
- Skid- or trailer-mounted with optional lifting bale
- 24-hour minimum capacity fuel tank
- 12 volt, electric start with control panel
- Compressor fitted to operate the air-ejector priming system
- Electric power options available

MATERIAL SPECIFICATIONS

- Standard Build
  - 316 Stainless Steel or Chromium Steel open impellers
  - Replaceable wear plates
- Pump Shaft
  - 431 Stainless Steel
  - All other components Spheroidal Graphite Iron
- Mechanical Seal
  - Solid silicon carbide mating faces
  - Oil-bath lubrication for dry running
- Suction / discharge flanges ANSI 300# FF

RAIN FOR RENT
P.O. Box 2248 • Bakersfield CA 93303
800 742-7246 • 661 399-9124 • FAX 661 393-1542
Internet: www.rainforrent.com

RFR 7/03



Power Prime Pumps
PUMP : XH-100
CURVE: 303026 1/03
SUCTION 150mm (6")
DISCHARGE 100mm (4")
MAX. SPHERE 22mm (.86")
IMPELLER CLOSED
IMPELLER ø560mm (22.05")
IMPELLER & WEAR PLATES 316 S/S (CF8M)
= RECOMMENDED PUMP OPERATING RANGE
1800RPM
1700RPM
1600RPM
1500RPM
1400RPM
167.5hp
134hp
100.5hp
67hp
201hp
234.5hp
B.E.P.
NOTE:
POWER CURVES INCLUDES AIR COMPRESSOR POWER CONSUMPTION
NPSHR
30FT
25FT
20FT
15FT
10FT
5FT
8M
6M
4M
2M
TOTAL HEAD
PSI
FT
M-T-R-S
US GPM
150
300
450
600
750
900
1050
1200
1350
1500
L/S
10
20
30
40
50
60
70
80
90
FLOW - CLEAR WATER PERFORMANCE

B.3 Example Monitor Nozzles

Example Monitor Products

Numerous companies provide lines of fire fighting monitor products. The following company information and specification sheets are provided as examples.

- Akron Brass (www.akronbrass.com; 330-264-5678) has many monitor product lines. The "Ozzie" line of monitors provide oscillation capability.

- Angus Fire (www.angusfire.co.uk) has many monitor product lines which are available in the U.S. through Kidde Fire. Their monitor products range from hand-held to very large (nearly 5,000 gpm) and include monitors with oscillating and remote control features.

- Chemguard (www.chemguard.com; 817-473-9964) has five lines of monitor nozzles, from small to larger trailer mounted. One of their monitor lines provide oscillation capability.

- Elkhart Brass (www.elkhartbrass.com; 800-346-0250) has a wide variety of portable monitors. A number of their monitors may be controlled by remote control.

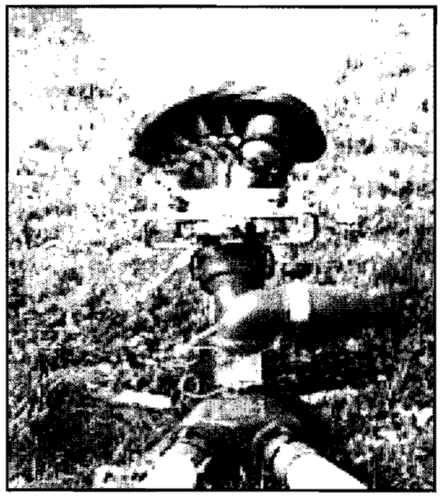
- Viking Corporation (www.vikingcorp.com; 877-384-5464) has several lines of monitor nozzles under the foam product lines, generally for use in fixed systems. Several of the monitors provide oscillation capability.

OZZIE OSCILLATING MONITORS

Akron® Ozzie Oscillating Monitors have powerful sweeping water streams for high performance attack and protection. Its unique water driven motor sweeps the outlet back and forth in a smooth, wave-like motion to provide cooling and protection while unmanned. Ozzie Oscillating Monitors operate by themselves to provide greater flexibility by protecting exposures while personnel work elsewhere. Ozzie Oscillating Monitors are suited for haz-mat situations, protecting exposures, and attacking fires.

- Adjustable sweeping range
- Vertical travel from 35° (Style 922: 45°) to 90° above horizontal
- On/Off knob can stop oscillation at any point
- Built-in pressure gauge

CE

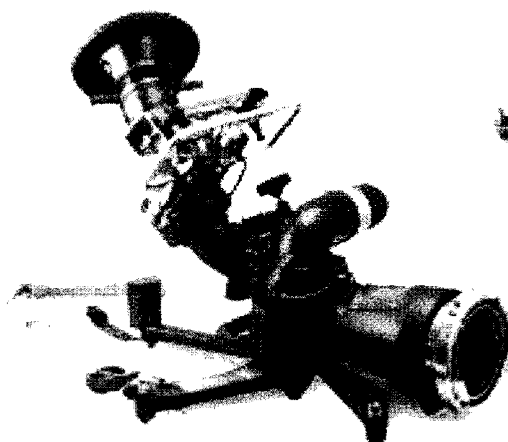


911 **Ozzie Oscillating Monitor**
- Sweeping range 30° either side of center

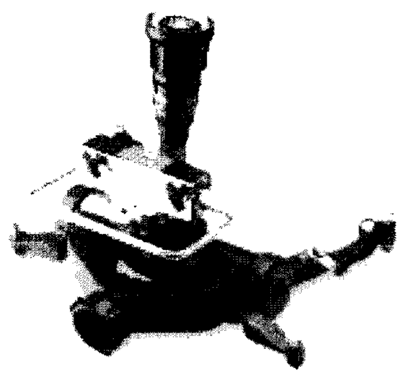
922 **OzzieMaster™ Oscillating Monitor**
An Ozzie Liftoff designed for use with an Apollo™ Ground Base (pages 34) - Must specify.
- Sweeping range 25° either side of center

STYLE	WEIGHT LBS.	HEIGHT	WIDTH	LENGTH	INLET	OUTLET	FLOW GPM	FLOW LPM
911	29	13 3/8"	23 3/4"	19 1/4"	2 1/2"	1 1/2"	375	1420
922	27 1/2*	13"	17 3/4"	21"	See Apollo Ground Base	2 1/2"	1000 Single Inlet 750 Dual Inlet	3800 Single Inlet 2900 Dual Inlet

* Less ground bases and nozzle



STYLE 922
Shown with Style 1745 TurboMaster™ Master Stream Nozzle mounted on Apollo Dual and Single Inlet Ground Bases



STYLE 911
Shown with Turbojet® Tip (Optional Tips: Assault™ 4824/4827)

Special Note On Direct Mounts:
A direct mount flange allows the OzzieMaster Oscillating Monitor to be used as a deck monitor.

ANGUS FIRE

Oscillating Monitor OM-80

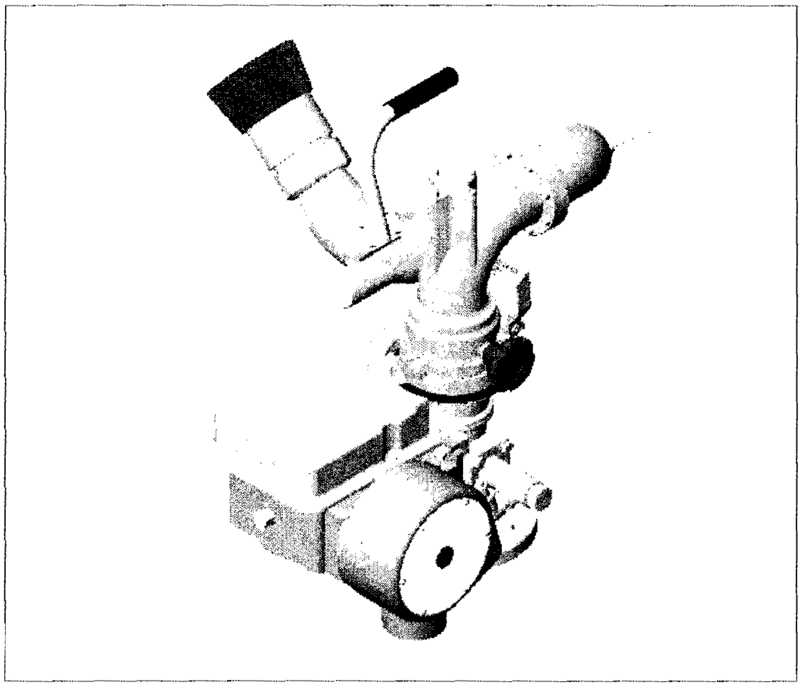
The exciting Streamline™ OM-80 is a nominal 80mm waterway Oscillating Monitor, designed to provide optimised hydraulic efficiency and long throw performance when the Streamline Long Throw (LTN) nozzles or (LTC) cannons are fitted. The compact low profile configuration, makes this monitor particularly suitable for installation on towers, aircraft hangars, offshore platforms for helideck protection and other areas where space is limited.

The OM-80 is engineered to the highest standards to withstand severe environmental conditions and provide exceptional operational reliability, long life and extremely low maintenance. Experience has shown a 20+ year life-span is achievable, even under harsh conditions. A sealed for life gearbox is provided with adjustable sweep angle between 45° and 120° in 15° intervals and an oscillating speed control. Sealed low friction joints ensure easy movement even at high operating pressures. A highly efficient pelton wheel water motor uses small quantities of fire main water to provide power for automatic oscillation. The OM-80 will therefore operate automatically, immediately after start up of the fire pump and requires no secondary (electric) power source. A quick release lever allows automatic oscillation to be overridden and re-engaged easily during operation.

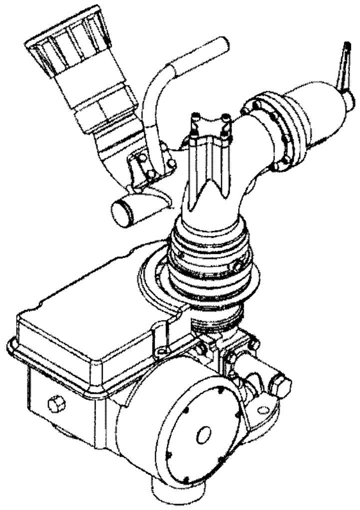
This Streamline oscillating monitor offers unique adaptability advantages, as it can be upgraded to suit your future changing needs. The OM-80 can be adapted to a remote control monitor specification over time if required. The whole Streamline range uses a common waterway platform design so key components can still be utilised to minimise cost as site requirements change. Upgrade kits are available, and most are field-fittable to the existing Streamline waterway by a competent site engineer.

When fitted with the Angus long throw range (LTN) of constant flow jet/spray nozzles the OM-80 is highly effective with water or film forming foams like Tridol AFFF and Petroseal FFFP for fast flame attack on hydrocarbon liquids on helidecks, aircraft hangars, process areas, tanker loading bays or bunded (diked) areas surrounding bulk storage tanks. Long throw foam cannons (LTC) can also be fitted which guarantee optimised foam quality and throw characteristics with the Angus range of foam concentrates. Maximum performance and throws of up to 68 metres can be achieved depending on nozzle/cannon configuration (see separate nozzle/cannon data sheets).

Sealed low friction joints provide easy elevation and horizontal movement even under high operating pressures. The quick and easy Clamp-Lok™ mechanism ensures the monitor is safely locked in position and can be left to operate unattended.



Two optional test kit are available. The dry test kit avoids passing any liquid onto the risk area to allow for periodic oscillation testing of the monitor. The wet test kit requires a separate temporary water test line to test the pelton wheel.



SPECIFICATION

Operating pressure	Max: 16 bar g	Min: 5 bar g (4 bar g to special order)
Test pressure	24 bar g	
Maximum flow	3,600 litres/min	
Inlet flange connections	4" ANSI Class 150 RF (alternatives to special order)	
Outlet connections	2", 2½" BSP Male or flanged to LTC cannons (alternatives to special order)	
Sweep angle	Automatic: 45° to 120° in 15° intervals	Manual: 360° continuous
Nominal elevation*	Max +75° above horizontal (+85° in upright mode)	
Nominal depression*	Max -70° below horizontal. Limited to -5° over gearbox in low profile mode. Limited to -45° or -20° over gearbox in upright mode	
Nominal oscillating frequency	8 cycles/min @ 7 bar g	
Nominal flow rate through water motor	30 litres/min @ 7 bar g	
Approx. weight (without nozzle/cannon)	75 kg	

* Low profile to upright mode adjustable on site (see O&M maual)

MATERIALS

Monitor body		Aluminium Bronze AB2 and Gunmetal LG2 to BS EN 1982	
Gearbox		Cast SG iron to BS2789 with phosphor bronze worm wheels, hardened worm shaft and stainless steel Input/output shaft	
Water motor pelton wheel		Phosphor bronze to BS EN 1982	
Seals		Nitrile synthetic rubber	
Finish	Monitor	Natural *(Red to special order)*	
	Gearbox cover	Phenolic Heat resistant laminate	
Grab handle		Stainless steel 316	
Fasteners		Stainless steel A2	
Optional Test kits		Dry test kit: AES 25917	Wet test kit (25mm Storz): AE 25657

THAME PARK ROAD, THAME, OXFORDSHIRE, OX9 3RT, ENGLAND
Tel: +44 (0)1844 265000 Fax: +44 (0)1844 265156
e-mail: general.enquiries@kiddeuk.co.uk

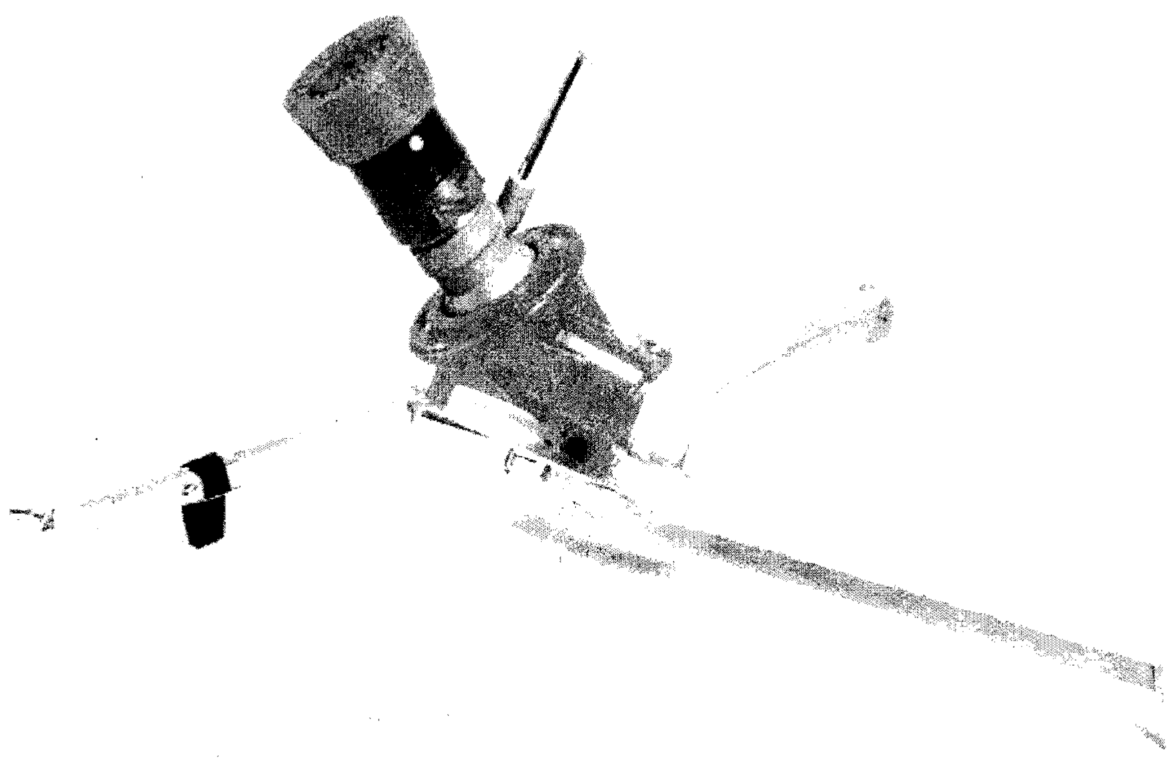
ANGUS FIRE

ANGUS FIRE

Portable Ground Monitor PGM

The Streamline Portable Ground Monitor has been specially designed to combine very light weight with excellent stability. It is robust and effective and can very quickly be brought into use. It folds compactly for vehicle stowage. It is intended for use in the medium output range, typically up to 400 g.p.m. (1800 l.p.m.) but higher outputs can be tolerated by using the anchor spike which is also recommended for use on smooth surfaces to assist in resisting jet reaction forces. Very little maintenance is needed. We strongly recommend the use of the purpose designed Angus Monitor Nozzles N.900 or N.1800. These have the added advantage of being matched to Angus Foam Inductors so that light unaspirated foams can be applied instead of water, when required. A highly effective aspirated foam blanket can be provided by using an F900/H branchpipe and Angus Portable Inductors.

- Lightweight
- Low maintenance
- Compact
- Low pressure loss design
- Highly durable - corrosion resistant materials



SPECIFICATION

The monitor consists of a two way collecting head mounted on a folding stainless steel ground frame. The Monitor outlet is a ball and socket design which provides direct control over a wide area. The natural reaction force of the water is sufficient to maintain position and at the same time permit adjustment during operation. The unit incorporates a swinging flap valve to permit use of a single hose if required.

Standard inlet connections are 2½" Instantaneous but alternative system hose connectors can be fitted. The standard outlet connection is 2½" BSP male thread but this can also be adapted as desired to hose connectors to permit the use of various nozzles.

Weight:without nozzle 7Kgs.

MATERIALS

Collecting head/outlet	Light alloy, anodised. External surfaces of the collecting head are thermoplastic coated and the swivel ball is coated with reinforced P.T.F.E.
Ground frame	Stainless steel.
Outlet connection	Steel, electroless nickel plated.
Internal fittings	Stainless steel.
Seals	Synthetic rubber.

ORDER REFERENCES

A241010	Ground Monitor with 2½" BSP (m) outlet.
A 241011	Ground Monitor with 2½" Inst. Female outlet.
A 241000	Ground Monitor with 2½" BSP (m) connections for other coupling Systems - please specify requirements.

For details of setting-up, maintenance and recommended flow rates, please ask for Data Sheet Series DA 2410. Overall dimensions when folded 950 mm long x 230 mm wide x 320 mm high.

THAME PARK ROAD, THAME, OXFORDSHIRE, OX9 3RT, ENGLAND
Tel: +44 (0)1844 265000 Fax: +44 (0)1844 265156
e-mail: general.enquiries@kiddeuk.co.uk

ANGUS FIRE

Water Powered Oscillating Monitors

Chemguard Water Powered Oscillating Monitors are designed to automatically discharge over a specific design area upon system activation. These are suitable for use in high risk areas such as tank farm facilities, aircraft hangars, offshore, refineries, chemical plants, and heliports.

SPECIFICATIONS

A water drive wheel connected to a double reduction gearbox drives the oscillating mechanism. To operate the drive wheel, a small quantity of flow diverted from the monitor inlet. The monitor requires no external wiring or hydraulic control for operation. The drive wheel design is unique in that it does not require an inlet filter. This makes the oscillating mechanism highly reliable and less likely to fail.

The vertical angle of elevation and horizontal arc of oscillation is field adjustable and can be set and locked in position. The monitor can be set to oscillate over a range of 0°-120° and the oscillation arc can be set anywhere within the 360° field of operation. Elevation range of the unit is between +80° and -40°.

FEATURES

- The monitor and body of the oscillating unit are manufactured of brass. The water drive wheel is bronze with bronze supply gate valve.
- CWPOM is UL Listed with CMNB350, CMNB500 and CMNB750 monitor nozzles only
- Capable of flowing foam or water
- Unique water drive wheel design
- Arc of oscillation adjustable via 6 set points
- Speed of oscillation adjustable from 0°-30°/sec. (24° /sec. @ 100 psi)
- Manual override capabilities in both horizontal and vertical degree fields
- Minimum operating pressure 40 psi (2.8 Bar)
- Maximum operating pressure 200 psi (14 Bar)
- Flow of water/foam solution through water drive wheel:

  At 50 psi (3.5 Bar) 5 gpm (19 lpm)
  At 100 psi (7 Bar) 8 gpm (30 lpm)
- Double reduction oil bath gearbox
- Grease fittings and two rows of stainless steel ball bearings at all rotation joints on monitor
- All brass and stainless steel construction
- Monitor has one tiller bar control for manual control
- Unit equipped with a garden hose test connection. This allows functional check of the oscillation mechanism without system flow.

CHEMGUARD
204 S. 6th Ave • Mansfield, Tx 76063 • (817) 473-9964 • FAX (817) 473-0606
www.chemguard.com

DATA SHEET #D10D03083
REVISION: 09/2005

ORDERING INFORMATION

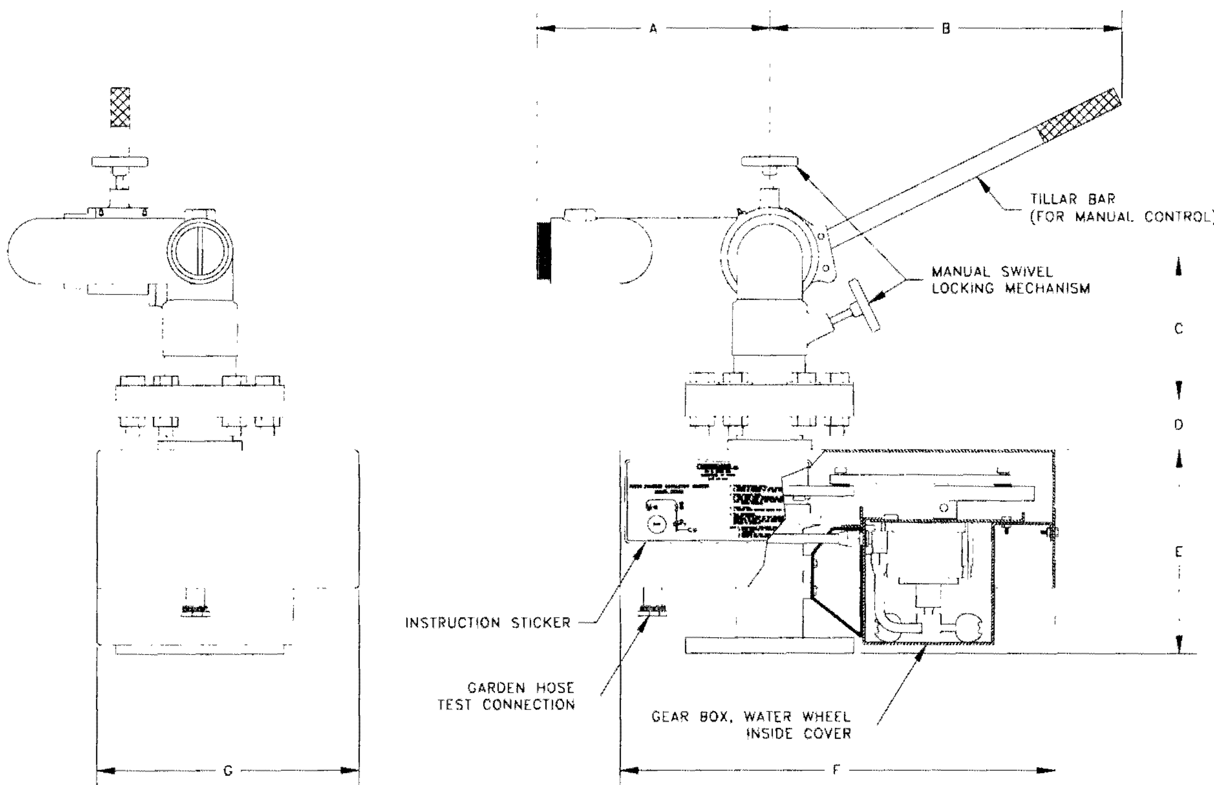
Part No:	Approx. Shipping Weight
CWPOM	120 LBS. (54 KG)
EF10155	150 LBS. (68 KG)

Note: Monitor nozzles sold separately.

Dimensional/Flow Data

Part No.	Inlet	Discharge	Waterway	Max. Flow, gpm	A	B	C	D	E	F	G
CWPOM	4"	2-1/2"	3"	1250	13"	17"	8"	3"	11"	23"	14"
EF10155	4"	3-1/2"	4"	2000	14.5"	18.8"	8"	3"	11"	23"	14"

Note:
1. Monitor inlets are ANSI Class 150 Flat Face flanges.
2. Monitor discharges are Male NST threads.
3. Flow Ratings are at 100 psi. Maximum operating pressure is 200 psi.
4. Dimensions are approximate and subject to change.



WATER POWERED OSCILLATING MONITOR

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DATA SHEET #D10D03083
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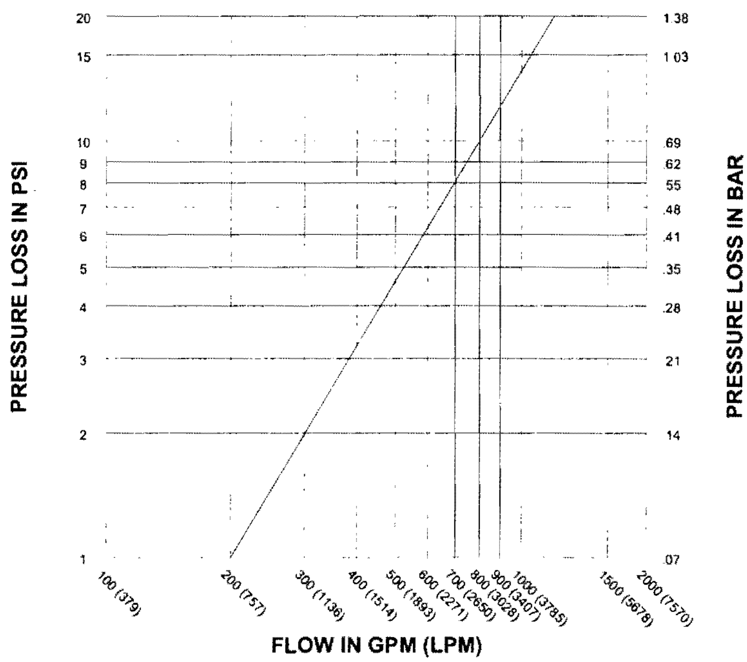
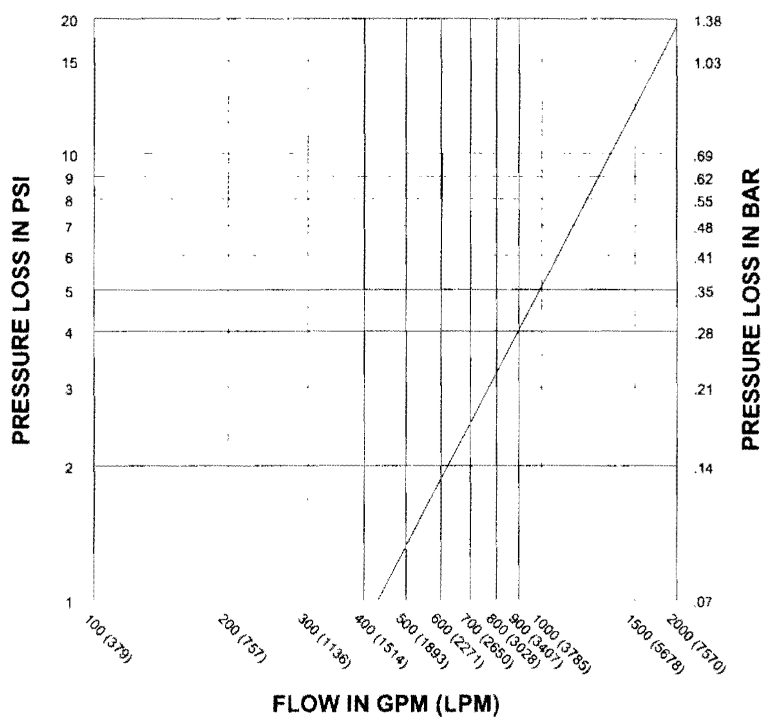
CM-1250 SERIES AND CWPOM MONITOR PRESSURE LOSS VS. FLOW CHART



CM-2000 SERIES AND EF10155 MONITOR PRESSURE LOSS VS. FLOW CHART



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DATA SHEET #D10D03083
REVISION: 09/2005

Water Powered Oscillating Monitor Range Data

Chemguard Water-Powered Oscillating Monitor Range Data - Reach In Feet (Height In Feet**)							
Monitor Model Number	Monitor Elevation Angle	Monitor Inlet Pressure - PSI (Bar)					
		50 - (3.45)		100 - (6.9)		150 - (10.3)	
		Fixed	Oscillating	Fixed	Oscillating	Fixed	Oscillating
CWPOM-350	**5**	60 (8)	55 (8)	110 (10)	100 (9)	135 (12)	120 (10)
	15	90 (15)	80 (14)	135 (20)	125 (18)	170 (23)	150 (21)
	30*	100 (25)	90 (23)	145 (32)	135 (30)	175 (39)	155 (35)
CWPOM-500	**5**	65 (9)	60 (9)	115 (10)	105 (9)	150 (13)	135 (11)
	15	95 (16)	85 (15)	155 (23)	145 (21)	185 (25)	165 (23)
	30*	105 (26)	95 (24)	165 (36)	150 (33)	200 (44)	180 (40)
CWPOM-750	**5**	70 (10)	65 (10)	120 (11)	105 (11)	160 (14)	140 (13)
	15	98 (16)	88 (16)	155 (23)	146 (21)	185 (25)	168 (23)
	30*	115 (28)	98 (25)	170 (36)	150 (33)	210 (45)	183 (42)
CWPOM-1000	**5**	70 (10)	65 (10)	125 (11)	107 (11)	165 (14)	145 (13)
	15	95 (16)	85 (16)	155 (24)	136 (22)	190 (25)	170 (23)
	30*	120 (27)	100 (25)	200 (38)	170 (35)	225 (46)	190 (43)
CWPOM-1200	**5**	75 (11)	70(11)	130 (11)	115 (11)	168 (14)	145 (13)
	15	100 (16)	90 (167)	165 (25)	150 (24)	195 (25)	170 (24)
	30*	130 (28)	110 (27)	225 (38)	195 (35)	230 (46)	195 (44)
CWPOM-2000	**5**	85 (12)	80 (11)	140 (12)	125 (12)	180 (15)	160 (14)
	15	115 (18)	105 (16)	180 (26)	165 (25)	210 (27)	190 (26)
	30*	150 (32)	130 (28)	260 (43)	220 (40)	275 (50)	240 (48)

* Maximum discharge range is achieved at approximately 30-35 degrees elevation
** Some ranges based on extrapolation of existing data and observations
NOTE: Maximum height of discharge stream is usually found at approximately 65% of maximum discharge range from nozzle, not at maximum discharge range.

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DATA SHEET #D10D03083
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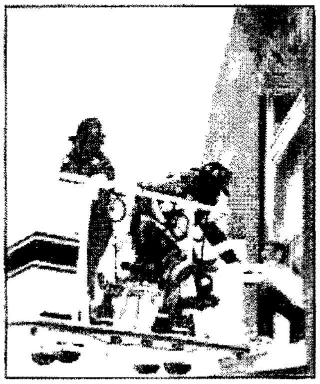
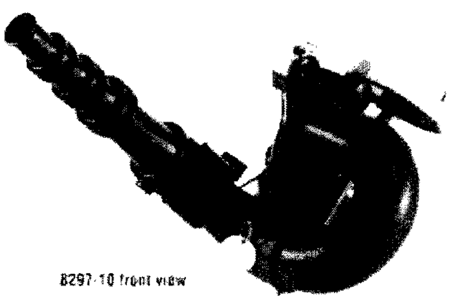




8297-10 front view

Features

- Durable, Lightweight ELK-O-LITE Construction
- Flow Efficient 3.0" Waterway
- Fully Enclosed Worm Gear
- Handwheel Controlled Vertical Travel
- Safety Stop at 35 Degrees Above Horizontal (Can be overridden in Deck Mount Mode)
- 95 Degree Vertical Travel (In Deck Mount Mode)
- Convenient Carrying Handle
- Safety Lock for Base Release
- 360 Degree Horizontal Rotation (In Deck Mount Mode)
- Positive Horizontal Twist Lock
- Grease Fitting for Easy Lubrication
- Liquid-Filled Pressure Gauge
- Six Optional Portable Bases with Folding Legs
- Rugged, Cast Almag Legs
- Positive Leg Locks
- Self-Adjusting Ground Spikes with Carbide Tips
- Convenient Carrying Handle (For Portable Base)
- Free-Swivel Connections on All Single Inlet Bases
- Two Optional Deck Mounts
- Flow Efficient 282A Stream Shaper
- Quad-Stacked Tips ST-194
- Heavy-Duty 10' Safety Chain (not shown)

Benefits

- Years of Dependable Service
- Two Guns in One – Deck and Portable
- Flows up to 1250 GPM
- Minimal Friction Loss
- Easy Deployment by One Person
- Stores Easily – Compartment, Running [illegible] or Tailboard
- Safe Operation up to Maximum Flow [illegible]
- Supply with 2.5", 3.0", 3.5" or LDH [illegible] Mode
- Preconnect Portable Base for [illegible]
- Pre-plumb for Top Mount Installation
- Supply Deck Mount Fixture with [illegible] Lengths
- Easy, Minimal Field Maintenance
- Elkhart Quality

Stinger®... The Industry Leader [illegible] Dual-Purpose Monitors

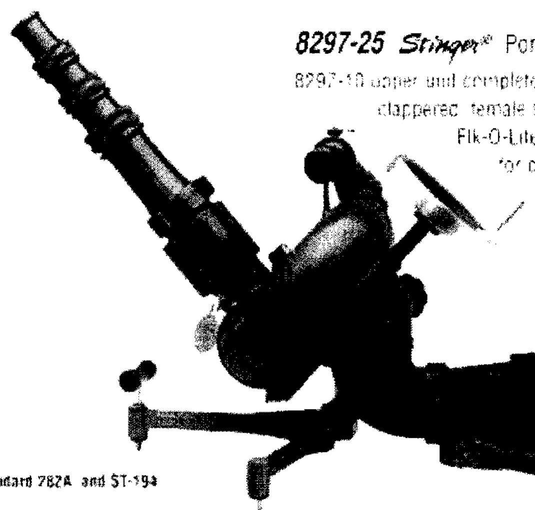
8297-10 rear view

8297-10 Stinger® Upper Unit

Durable, lightweight Elk-O-Lite construction • Can be deployed on any of 6 portable bases • [illegible] on either of 2 top deck mount fixtures • Carrying handle doubles as quick [illegible] mechanism • Full 3.0" unobstructed waterway for flow efficiency up to 1250 GPM • Hand [illegible] driven vertical worm gear fully enclosed for protection from the elements • Grease fitting [illegible] easy lubrication • Vertical travel from 70° above to 25° below horizontal in deck mount mode • Safety stop at 35° above horizontal for portable mode • Full 360° travel in deck mount [illegible] positive twist lock • Liquid filled pressure gauge • Flow rated at 1250 GPM in deck mount [illegible] 1000 GPM with single inlet portable base and 800 GPM with the double 2.5" portable base • Standard with 282A stream shaper and ST-194 quad-stacked tips • Finish red urethane [illegible] with hard anodized trim

8297-25 Stinger® Portable Monitor (2-2.5" Swivels)

8297-10 upper unit complete with portable base • For flows up to 800 GPM • Two 2.5" clappered female swivel inlets • Base body constructed of durable lightweight Elk-O-Lite • Rugged cast Almag legs lock in place for deployment and [illegible] for compact storage • Self-adjusting ground spikes with carbide [illegible] • Furnished with 10' safety chain • Finish red urethane [illegible] hard anodized trim



8297-25 w/standard 282A and ST-194

VIKING® TECHNICAL DATA

WATER POWERED OSCILLATING MONITOR MODEL HOM4A

1. PRODUCT NAME
Water Powered Oscillating Monitor
Model HOM4A

2. MANUFACTURER
National Foam
P O Box 270
Exton PA 19341 USA
Telephone: (610) 363-1400
Fax: (610) 524-9073

3. PRODUCT DESCRIPTION
The HOM4A Water-Powered Oscillating Monitor provides unparalleled performance with simple, yet rugged, design features in a very compact package. The monitor is designed to provide an oscillating water or foam stream over a preset area of protection. The monitor is supplied with an integral, non-aspirating nozzle which is available with flow rate choices from 600 to 1200 gpm (2271-4242 lpm) @ 100 PSI (6.9 Bar) inlet pressure to the monitor connection.

4. TECHNICAL DATA
Materials of Construction:
Monitor: Cast Aluminum and Stainless Steel
Oscillator: Brass, Stainless Steel, and Fiberglass
Osc. Enclosure: Steel, Epoxy-Coated
Finish: Red Epoxy for Monitor & Black Epoxy for Enclosure
Flow Range: 600 to 1200 gpm (2271-4242 lpm) @ 100 PSI (6.9 Bar)
Working Pressure: 50 PSI to 150 PSI (3.5 Bar to 10.3 Bar
Elevation / Depression: -20° to 45°
Arc of Oscillation: Adjustable - 10° to 180°
Oscillation Speed: Adjustable - 0 to 20°/sec
Weight: 95 Lbs. (43 kg)
Options:
Antifreeze kit

5. APPROVALS
- FM approved

6. FEATURES
- Extremely compact – 20" (508 mm) overall height with mounting base only 24" (610 mm) long x 15-1/4" (387 mm) wide.
- Simple set-up/adjustment features.
- All oscillating mechanism components constructed of brass, stainless steel and fiberglass for superior corrosion resistance and wear.
- Oscillating mechanism equipped with manual disengagement lever for quick and easy manual override.
- Manual disengagement mechanism features a clutch which automatically re-engages the oscillator to the previously set oscillation angle when monitor is moved anywhere within oscillation angle setting.
- Non-aspirating nozzles offer a unique, easy-to-set, infinitely adjustable spray pattern feature from straight stream to oval-shaped spray.
- Superior nozzle reach, since low profile permits nozzle elevation angle that optimizes performance while keeping stream below aircraft or other low level obstructions.
- Suitable for operating pressures from 50 PSI to 150 PSI (3.5 Bar to 10.3 Bar).
- Very efficient oscillation mechanism requires only 3 gpm (11.41 lpm) water flow.
- Test connection (3/4" garden hose) provides means to set oscillation mechanism without flow through the monitor.
- Angle of oscillation arc infinitely adjustable from 10° to 180°; takes only seconds to adjust.
- Oscillation speed infinitely adjustable from 0° to 20°/sec.
- Full 360° continuous rotation in manual mode.
- Angle of elevation is infinitely adjustable from 20° below horizontal to 45° above. A simple locking screw maintains elevation setting. Elevation lock incorporates a quick release for manual operation which when re-engaged locks elevation in original setting.
- Water inlet to oscillator assembly is the full 360° of interior surface and has an integral self cleaning strainer which eliminates the potential of clogging, as with single point connections.

7. APPLICATIONS
The HOM4A water-powered oscillating monitors are commonly used for under wing protection in aircraft hangars, helipads, loading racks and dike protection.

Replaces page 308a-d dated March 1, 2001. (Changed Model to National HOM from Viking VOM and reformatted page.)

They can also be used in marine applications such as docks and offshore platforms.

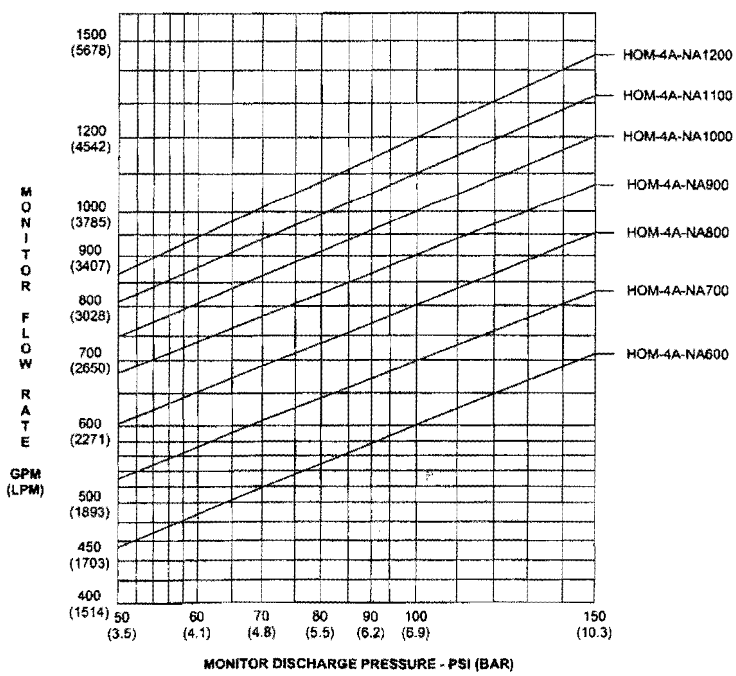
8. SPECIFICATIONS

Monitor shall be automatic oscillating type, requiring only water or foam solution inlet pressure to provide power to drive oscillator mechanism. The monitor shall be fabricated of cast aluminum and stainless steel, with all oscillating components constructed of brass, stainless steel and fiberglass for superior corrosion resistance and wear. Monitor inlet connection shall be a bottom mounted 4" 150# FF flange. Integral nozzle shall be non-aspirating type, designed for use with AFFF and Polar Solvent/AFFF type foams.

Spray pattern shall be easy-to-set and infinitely adjustable from straight stream to oval shaped spray. Elevation and depression shall be infinitely adjustable from 20° below horizontal to 45° above horizontal and shall be maintained by a locking screw. Elevation lock shall incorporate a quick release for manual operation which when re-engaged locks elevation in original setting.

Oscillation mechanism shall utilize a rugged, efficient, stainless steel cable drive arrangement. Arc of oscillation shall be easy to set in the field and shall be infinitely adjustable from 10 to 180 degrees. Unit shall be equipped with a manual oscillation disengagement mechanism with clutch which automatically re-engages the oscillator to the previously set oscillation angle when monitor is moved anywhere within oscillation angle setting. Monitor shall have continuous 360° rotation in manual mode.

Oscillator assembly shall have an adjustable oscillation speed of 0 - 20°/sec and shall operate with a minimum inlet pressure of 50 PSI. Water flow required to operate oscillation mechanism shall not exceed 3 Gpm (11.41 lpm). Water inlet to oscillator assembly shall be full 360° of interior surface and shall have an integral, two ply, self cleaning strainer, consisting of a finer inner mesh covered by perforated stainless steel outer cover. Surface area of strainer to area of pipe supplying oscillator shall exceed 50 to 1.



HOM-4A FLOW RATE VS. PRESSURE CHART

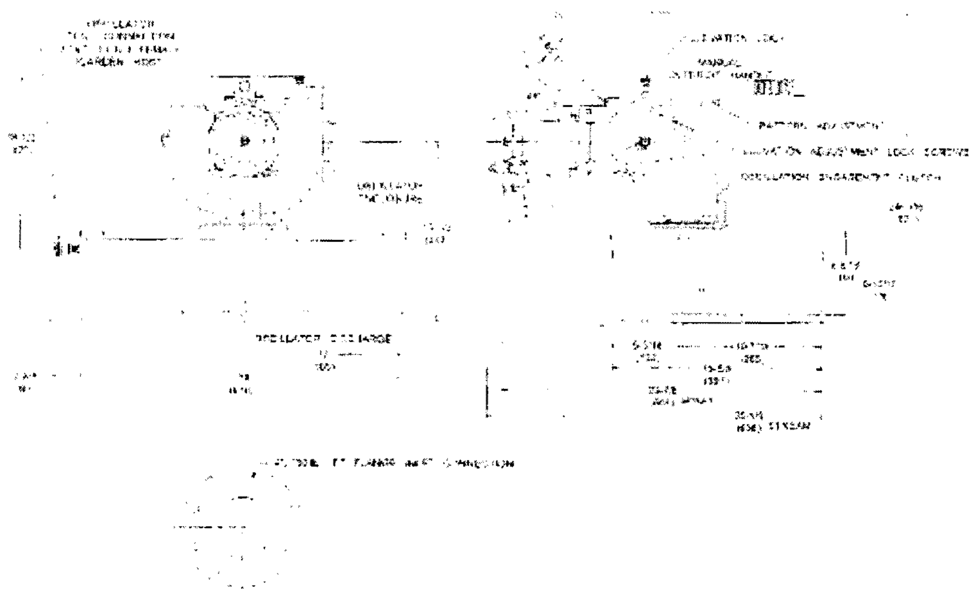
VIKING® | **TECHNICAL DATA** | **WATER POWERED OSCILLATING MONITOR MODEL HOM4A**

Unit shall have external test connection (3/4"-11 ½ NH garden hose swivel) for testing monitor oscillation without flowing water through the unit. Oscillation and speed adjustment shall be located under protective housing to prevent tampering.
Monitor must have a low profile design with a maximum unit height not exceeding 19 inches overall.

Flow and range ratings of each unit shall be as shown on the appropriate curve and shall be based on the inlet pressure to the monitor and not the nozzle. Maximum working pressure shall be 150 PSI (10.3 Bar). Monitor unit shall be F.M. Approved.

Notes:

1. Monitor oscillation system shall be charged with a 50% solution of glycol based anti-freeze and water to protect against corrosion and freezing in cold climates.
2. Monitor shall have 15" radius of clear area about center of 4" inlet connection to prevent interference with oscillating monitor.
3. Monitor inlet flange is tapped. Use 5/8-11 x 2" screws for installation.



HOM4A MONITOR WITH NON-ASPIRATING NOZZLE

VIKING®

TECHNICAL DATA

WATER POWERED OSCILLATING MONITOR MODEL HOM4A

ORDERING INFORMATION

Viking Part Number	Model #	Flow @ 100 PSI (6.9 Bar)	
		GPM	LPM
F02185	HOM4A-NA600	600	2271
F02186	HOM4A-NA700	700	2650
F02187	HOM4A-NA800	800	3028
F02188	HOM4A-NA900	900	3407
F02189	HOM4A-NA1000	1000	3785
F02190	HOM4A-NA1100	1100	4164
F02191	HOM4A-NA1200	1200	4542

Range Data- Feet

Model No.	Incl. Angle (o)	Monitor Inlet Pressure-PSI (BAR)									
		50 (3.45)		75 (5.17)		100 (6.9)		125 (8.62)		150 (10.3)	
		FIXED	OSC**	FIXED	OSC**	FIXED	OSC**	FIXED	OSC**	FIXED	OSC**
600	10	60	51	85	72	115	98	150	128	165	140
	15	80	68	105	89	135	115	160	136	185	149
	22.5	95	81	120	102	150	128	170	145	190	162
	30	110	94	135	115	165	140	175	149	195	166
700	10	60	51	85	72	115	98	150	128	165	140
	15	80	68	110	94	140	119	170	145	190	162
	22.5	100	85	130	111	165	140	190	162	210	179
	30	115	98	140	119	175	149	195	166	215	183
800	10	60	51	85	72	120	102	150	128	175	149
	15	85	72	115	98	155	132	185	157	205	174
	22.5	105	89	135	115	175	179	205	174	215	183
	30	120	102	145	123	180	153	210	179	220	187
900	10	65	55	90	77	125	106	155	132	175	149
	15	85	72	115	98	160	136	185	157	205	174
	22.5	105	89	140	119	180	153	210	179	220	187
	30	120	102	150	128	190	162	215	183	225	191
1000	10	65	55	90	77	125	106	155	132	175	149
	15	85	72	115	98	160	136	190	162	210	179
	22.5	110	94	140	119	185	157	210	179	225	191
	30	125	106	155	132	195	166	215	183	230	196
1100	10	70	60	95	81	130	111	155	132	175	149
	15	90	77	125	106	170	145	195	166	210	179
	22.5	110	94	145	123	190	162	215	183	225	191
	30	125	106	155	132	200	170	220	187	230	196
1200	10	75	64	100	85	135	115	160	136	175	149
	15	95	81	130	111	175	149	200	170	215	183
	22.5	115	98	150	128	195	166	215	183	230	196
	30	130	111	160	136	205	174	225	191	235	200

NOTE: * To obtain range in meters – multiply range in feet by 0.3048
**Oscillation rate at nominal 10°/second

Replaces page 308a-d dated March 1, 2001. (Changed Model to National HOM from Viking VOM and reformatted page.)

APPENDIX C

Example EDMG Templates

C.1 PWR EDMG Example

Example PWR EDMG

Guideline Usage:

This document is a Guideline. This Guideline should NOT be used unless entry has been directed from PROCEDURE1

Verbatim compliance with the steps of this Guideline is not required.

This Guideline should be used by the implementers to aid in making the necessary decisions to combat a severe accident involving beyond design basis conditions.

Use of opposite unit personnel may be called for, depending on the situation at the affected unit.

Steps, procedure limitations and precautions selected at the discretion of the User.

Example PWR EDMG

1. Purpose
   1.1. The Guideline provides initial actions and alternative methods of plant operation for responding to an event that results in a total loss of unit power (AC and DC), or prevents operation from the Control Room or the Remote Shutdown Panel.

2. Entry Conditions
   2.1. This guideline is entered from PROCEDURE1 after it has been determined that control of plant equipment cannot be established from the Control Room or the Remote Shutdown Panel.
   2.2. Declaration of 50.54(x) is required.

3. Scope
   3.1. Communciations (Attachment A)
   3.2. Notifications/ERO Callout
   3.3. Immediate local actions should be taken to verify reactor tripped and an auxiliary feedwater pump running, if verification from the Control Room is not possible.
   3.4. The TDAFW Pump is the primary method for providing feed flow to SGs during a complete loss of power. This pump has a design flow rate of 600 gpm, and can maintain some flow as long as steam supply pressure is greater than 50 psig.
   3.5. PROCEDURE2 provides the steps necessary to start the TDAFW Pump with no AC/DC power available.
   3.6. The TDAFW flow control valves fail open/closed on loss of power, so it will be necessary to establish an alternate method of flow control to prevent underfeeding/overfill of the steam generators.

Example PWR EDMG

Instructions

NOTE
Continue action steps begun in the EOP network unless specifically stopped by a recommendation from the TSC.

4.1. Assess Plant Damage Condition

4.1.1. Determine if control room is accessible and useable

4.1.2. Determine primary area of damage

4.2. Invoke Appropriate Regulatory Requirements

4.2.1. Refer to PROCEDURE3, "Control Room Emergency Operation," and determine applicability of 10CFR50.54(x) invocation.

4.2.2. Refer to PROCEDURE4, "Classification and PARs," and request unaffected unit complete the required NRC notifications.

4.3. Determine Communication Options

4.3.1. Use Attachment A to determine potential communication options if normal communication methods are affected

4.4. Perform Local Immediate Actions

Table 1 – Conditions Necessary to Perform Local Immediate Actions		
Condition	**Requirement**	**Special Tools/Equipment**
Access to Auxiliary Bldg and Turbine Bldg	Confirm it is safe to access.	Portable lighting may be required

4.4.1. Verify Reactor Trip

a) Locally check reactor trip breakers – OPEN

1) *<u>IF</u> reactor trip breakers are <u>NOT</u> OPEN, <u>THEN</u> manually trip breakers.*

2) *<u>IF</u> reactor trip breakers do <u>NOT</u> manually open, <u>THEN</u> open both MG set output contactors locally.*

Example PWR EDMG

4.5. Locally Start TDAFP

4.5.1. DETERMINE conditions necessary to operate TDAFW Pump.

Table 2 – Conditions Necessary to Operate TDAFW Pump		
Condition	**Required**	**Special Tools/Equipment**
Access to BUILDING1	Confirm that radiation levels and temperatures permit access	Portable lighting required may be required.
Steam supply from at least one SG	Steam supply pressure >X1 psig	N/A
Speed indication	If instrument power is lost, use local speed indication.	Handheld strobe light tachometer
Cooling	Not required	Block doors open to provide ventilation, if necessary
	TDAFW Pump Available	**Yes / No**

4.5.2. Refer to PROCEDURE2 and locally start TDAFP in manual.

4.6. Check Plant Status

4.6.1. Complete Attachment B

4.7. Implement Actions as Directed by TSC

- Desired lineups
- Imposed limitations
- Special parameter monitoring
- Tank refilling

Example PWR EDMG

References

PROCEDURE1 – Procedure directing entry into this guideline

PROCEDURE2 – Procedure for Operating TDAFW pump without power

PROCEDURE3 – Procedure for invoking 50.54(x)

PROCEDURE4 – Procedure for Event Classification

PROCEDURE5 – Procedure for standard lineup of AFW suction water source

PROCEDURE6 – Procedure for alternate supply to AFW suction water source

ATTACHMENT A of PWR EDMG

Communication Options

Example PWR EDMG

COMMUNICATIONS ASSESSMENT FOR DAMAGE TO KEY STRUCTURES

------ EXAMPLE ONLY -----

Structure Affected	Plant Radios	Plant Pagers	Plant Telephones	Plant Pager	Plant Process Computer	Satellite Phone
Turbine	Operable May be affected in damage zone due to loss of antennas.	Operable May be affected in damage zone due to loss of antennas.	Operable for calls within the station until batteries deplete.	Operable except in affected areas.	Not Available	Operable
Control	Not Operable	Not Operable	Not Operable	Operable except in affected areas.	Not Operable	Operable
Auxiliary	Not Operable	Operable May be affected in damage zone due to loss of antennas.	Operable except in affected areas.	Not Operable	Operable except in affected areas.	Operable
Intake Structure	Operable May be affected in damage zone due to loss of antennas	Operable May be affected in damage zone due to loss of antennas.	Operable except in affected areas.	Operable except in affected areas.	Operable except in affected areas.	Operable
Containment	Operable May be affected in damage zone due to loss of antennas	Operable May be affected in damage zone due to loss of antennas.	Operable except in affected areas.	Operable except in affected areas.	Operable except in affected areas.	Operable
etc.						

ATTACHMENT B of PWR EDMG

Plant Damage Assessment

DAMAGE ASSESSMENT OF KEY STRUCTURES

------ EXAMPLE ONLY -----

Building	Elevation	Visible Damage	Accessibility	Equipment Status/System Integrity
Containment	n/a			
Control	57'			
	77'			
	111'			
	139'			
Auxiliary	21'			
	57'			
	77'			
	111'			
	139'			
Turbine	66'			
	92'			
	115'			
	145'			
Intake Structure	All			

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Example PWR EDMG

C.2 BWR EDMG Example

BWR EXTREME DAMAGE MITIGATION GUIDELINE

ENTRY CONDITIONS

A large area of the station has been damaged due to explosive OR fire. This procedure should be entered from events resultant from an entry into PROCEDURE1

General Instructions

Verbatim compliance with the steps of this Guideline is not required.

This Guideline should be used by the implementers to aid in making the necessary decisions to combat a severe accident involving beyond design basis conditions.

Use of opposite unit personnel may be called for, depending on the situation at the affected unit.

Steps, procedure limitations and precautions selected at the discretion of the User.

Consider invocation of 50.54(x) per PROCEDURE3

If the event has NOT already been classified and the emergency plan activated, classify the event and activate the emergency plan in accordance with PROCEDURE4

Based on communication systems availability establish alternate means of communication with offsite authorities and site personnel, refer to Attachment A.

Enter and execute all application SAPs/EOPsSOPs concurrently with this procedure.

INITIAL ASSESSMENT

- Determine where primary damage has occurred in order to assess options that may be available

Highest Priority should be given to the following:

- Reactor Building
- Control Building
- Turbine Building

CORE COOLING RESPONSE STRATEGY

- Confirm Reactor Trip
- Confirm Automatic Start of RCIC

If RCIC did not start, then Use PROCEDURE2 to manually start and control RCIC

INITIAL DAMAGE ASSESSMENT

- Perform initial damage assessment using Attachment B

Highest Priority should be given to the following:

- Reactor Building
- Control Building
- Turbine Building

Example BWR EDMG

COMMUNICATIONS ASSESSMENT FOR DAMAGE TO KEY BWR STRUCTURES
------ EXAMPLE ONLY -----

Structure Affected	Plant Radios	Plant Pagers	Plant Telephones	Plant Pager	Plant Process Computer	Satellite Phone
Turbine	• Operable • May be affected in damage zone due to loss of antennas.	• Operable • May be affected in damage zone due to loss of antennas.	• Operable for calls within the station until batteries deplete.	• Operable except in affected areas.	• Not Available	• Operable
Control	• Not Operable	• Not Operable	• Not Operable	• Operable except in affected areas.	• Not Operable	• Operable
Reactor	• Not Operable	• Operable • May be affected in damage zone due to loss of antennas.	• Operable except in affected areas.	• Not Operable	• Operable except in affected areas.	• Operable
Intake Structure	• Operable • May be affected in damage zone due to loss of antennas	• Operable • May be affected in damage zone due to loss of antennas.	• Operable except in affected areas.	• Operable except in affected areas.	• Operable except in affected areas.	• Operable
etc.	•	•	•	•	•	•

Example BWR EDMG

DAMAGE ASSESSMENT OF KEY BWR STRUCTURES
------ EXAMPLE ONLY -----

Building	Elevation	Visible Damage	Accessibility	Equipment Status/System Integrity
Control	57'			
	77'			
	111'			
	139'			
Reactor	21'			
	57'			
	77'			
	111'			
	139'			
Turbine	66'			
	92'			
	115'			
	145'			
Intake Structure	All			